DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 218

[Docket No. 160920860–7368–01]

RIN 0648–BG35

Taking and Importing Marine Mammals: Taking Marine Mammals Incidental to U.S. Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active Sonar

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS has received a request from the U.S. Navy (Navy) for authorization to take marine mammals, by harassment, incidental to conducting operations of Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar in areas of the world's oceans (with the exception of Arctic and Antarctic waters and certain geographic restrictions), from August 15, 2017, through August 14, 2022. The Navy's activities are considered military readiness activities pursuant to the Marine Mammal Protection Act (MMPA), as amended by the National Defense Authorization Act for Fiscal Year 2004 (FY 2004 NDAA). Pursuant to the MMPA, NMFS is requesting comments on its proposal to issue regulations to govern the incidental take of marine mammals by Level B harassment during the specified activity.

DATES: Comments and information must be received no later than May 30, 2017.

ADDRESSES: You may submit comments on this document, identified by NOAA–HQ–2017–0037, by either of the following methods:

Electronic Submission: Submit all electronic public comments via the Federal e-Rulemaking Portal. Go to *www.regulations.gov/#!docketDetail;D=NOAA-HQ-2017-0037*, click the ''Comment Now!'' icon, complete the required fields, and enter or attach your comments.

Mail: Comments should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, and may not consider comments received after the end of the comment period. Comments received electronically, including all attachments, must not exceed a 25-megabyte file size. Attachments to electronic comments will be accepted in Microsoft Word, Excel, or Adobe PDF formats only. To help NMFS process and review comments more efficiently, please use only one method to submit comments. All comments received are a part of the public record and will generally be posted to *www.regulations.gov* and *www.nmfs.noaa.gov/pr/permits/incidental/military* without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

FOR FURTHER INFORMATION CONTACT: Dale Youngkin, Office of Protected Resources, NMFS, (301) 427–8401. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained by visiting the Internet at: *www.nmfs.noaa.gov/pr/permits/incidental/military.htm*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

Section 101(a)(5)(A) of the MMPA (16 U.S.C. 1361 *et seq.*) directs the Secretary of Commerce (Secretary) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals in a specified geographical region for a period of up to five years, provided that certain findings are made and the necessary prescriptions are established.

The incidental taking of marine mammals shall be allowed if NMFS (through authority delegated by the Secretary) finds that the total taking by the specified activity during the specified time period will (1) have a negligible impact on the species or stock(s) and (2) not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). Further, the permissible methods of taking and other means of effecting the least practicable adverse impact on the species or stock and its habitat (*i.e.,* mitigation) must be prescribed. Requirements pertaining to the monitoring and reporting of such taking must also be set forth.

The allowance of incidental taking under section 101(a)(5)(A) requires promulgation of activity specific regulations. Subsequently, a Letter (or Letters) of Authorization (LOA) may be issued as governed by the regulations, provided that the level of taking will be consistent with the findings made for the total taking allowable under the specific regulations. The promulgation of regulations (with their associated prescribed mitigation, monitoring, and reporting) requires notice and opportunity for public comment.

NMFS has defined ''Negligible impact'' in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

The National Defense Authorization Act for Fiscal Year 2004 (FY 2004 NDAA) (Pub. L. 108–136) removed the ''small numbers'' and ''specified geographical region'' limitations indicated above and amended the definition of ''harassment'' as it applies to a ''military readiness activity'' to read as follows (Section 3(18)(B) of the MMPA): ''(i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild'' (Level A Harassment); ''or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including but not limited to migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered'' (Level B Harassment). In addition, the FY 2004 NDAA amended the MMPA as it relates to military readiness activities and the Incidental Take Authorization (ITA) process such that ''least practicable adverse impact'' shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

Summary of Request

On August 26, 2016, NMFS received an application from the Navy requesting authorization for the take of individuals of 104 currently classified species or stocks of marine mammals (15 species of mysticete (baleen) whales, 60 species of odontocete (toothed) whales, and 29 species of pinnipeds (seals and sea lions)), by harassment, incidental to the use of SURTASS LFA sonar on a maximum of four U.S. Naval ships for routine training, testing, and military operations, hereafter called activities, in various areas of the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea from August 15, 2017 through August 14, 2022. These activities are classified as military readiness activities. The Navy states, and NMFS concurs, that these military readiness activities may incidentally take marine mammals present within the Navy's operation areas by exposing them to SURTASS LFA sonar at levels that constitute Level B harassment as defined above. The Navy requests authorization to take individuals of the 104 currently classified species or stocks of marine mammals by Level B Harassment. This rule may also cover the authorization of additional associated stocks of marine mammals not listed here, should one or more of the stocks identified in this rule be formally separated into multiple stocks, provided NMFS is able to confirm the necessary findings for the newly identified stocks. As discussed later in this document, takes due to SURTASS LFA sonar will be limited to Level B behavioral harassment. No takes by Level A harassment will be authorized as Level A harassment will be avoided through the implementation of the Navy's proposed mitigation measures. In previous rulemakings, NMFS authorized small numbers of Level A takes out of an abundance of caution even though Level A takes were not anticipated. However, there have been no Level A takes resulting from the past 14 years of SURTASS LFA sonar activities under previous rules. Additionally, the criteria and thresholds for assessing Level A harassment have been modified since prior rules. Under the new metrics, the potential for injury zone has been substantially reduced. Therefore, due to the small injury zones and the fact that mitigation measures would ensure that marine mammals would not receive levels associated with injury, the Navy has not requested authorization for Level A harassment takes, and NMFS is not proposing to authorize any takes by Level A harassment.

This is NMFS' fourth rulemaking for SURTASS LFA sonar activities under the MMPA. NMFS' current five-year regulations governing incidental takings incidental to SURTASS LFA sonar activities and the related Letters of Authorizations (LOA) expire on August 15, 2017. NMFS published the first SURTASS LFA sonar rule on July 16, 2002 (67 FR 46712), effective from August 2002 through August 2007. The second rule was published on August 21, 2007 (72 FR 46846), effective from August 16, 2007, through August 15, 2012. The third rule was published on August 20, 2012 (77 FR 50290), and is effective through August 14, 2017. For this proposed rulemaking, the Navy proposes to conduct the same types of sonar activities as they have conducted over the past 14 years with the following exception: The Navy proposes to transmit a maximum number of 255 hours of LFA sonar per vessel per year, as opposed to the previously authorized 432 hours of LFA sonar per vessel per year. Based on historical operating parameters, the average duty cycle (*i.e.,* the ratio of sound ''on'' time to total time) for SURTASS LFA sonar is normally 7.5 to 10 percent and the duty cycle is not expected to exceed 20 percent.

Description of the Specified Activities

Overview

The proposed action is Navy's continued employment of up to four SURTASS LFA sonar systems in the world's non-polar oceans, which is classified as a military readiness activity, from August 2017 to August 2022. Potential activities could occur in the Pacific, Atlantic, and Indian Oceans, and the Mediterranean Sea. The Navy will not operate SURTASS LFA sonar in Arctic and Antarctic waters. Additional geographic restrictions include maintaining SURTASS LFA sonar received levels below 180 dB re 1 µPa (root-mean-square (rms)) within 12 nautical miles (nmi) (22 kilometers (km)) of any land, and within the boundaries of designated Offshore Biologically Important Areas (OBIAs) during their effective periods (see below for more OBIA details).

Purpose and Background

The Navy's primary mission is to maintain, train, equip, and operate combat-ready naval forces capable of accomplishing American strategic objectives, deterring maritime aggression, and assuring freedom of navigation in ocean areas. This mission is mandated by Federal law in Section 5062 of Title 10 of the United States Code, which directs the Secretary of the Navy and Chief of Naval Operations (CNO) to ensure the readiness of the U.S. naval forces.

The Secretary of the Navy and the CNO have established that anti-submarine warfare (ASW) is a critical capability for achieving the Navy's mission, and it requires unfettered access to both the high seas and littoral environments to be prepared for all potential threats by maintaining ASW core competency. The Navy is challenged by the increased difficulty in locating undersea threats solely by using passive acoustic technologies due to the advancement and use of quieting technologies in diesel-electric and nuclear submarines. At the same time as the distance at which submarine threats can be detected decreases due to quieting technologies, improvements in torpedo and missile design have extended the effective range of these weapons.

One of the ways the Navy has addressed the changing requirements for ASW readiness was by developing SURTASS LFA sonar, which is able to reliably detect quieter and harder-to-find submarines at long range before these vessels can get within their effective weapons range to launch against their targets. SURTASS LFA sonar systems have a passive component (SURTASS), which is a towed line array of hydrophones used to detect sound emitted or reflected from submerged targets, and an active component (LFA), which is comprised of a set of acoustic transmitting elements. The active component detects objects by creating a sound pulse, or ''ping'' that is transmitted through the water and reflects off the target, returning in the form of an echo similar to echolocation used by some marine mammals to locate prey and navigate. SURTASS LFA sonar systems are long-range sensors that operate in the low-frequency (LF) band (*i.e.,* 100–500 Hertz (Hz)). Because LF sound travels in seawater for greater distances than higher frequency sound, the SURTASS LFA sonar system would meet the need for improved detection and tracking of new-generation submarines at a longer range and would maximize the opportunity for U.S. armed forces to safely react to, and defend against, potential submarine threats while remaining a safe distance beyond a submarine's effective weapons range. Thus, the active acoustic component in the SURTASS LFA sonar is an important augmentation to its passive and tactical systems, as its long-range detection capabilities can effectively counter the threat to the Navy and national security interests posed by quiet, diesel submarines.

Dates and Duration

Due to uncertainties in the world's political climate, a detailed account of future operating locations and conditions for SURTASS LFA sonar use over the next five years cannot be predicted. However, for analytical purposes, a nominal annual deployment schedule and operational concept were developed based on actual SURTASS LFA sonar activities conducted since January 2003 and projected Fleet requirements (See Table 1).

TABLE 1—EXAMPLE ANNUAL DEPLOYMENT SCHEDULE FOR ONE SURVEILLANCE VESSEL USING SURTASS LFA SONAR

On mission	Days	Off mission	Days
Transit	54	In-Port Upkeep	40
Active Activities	240	Regular Overhaul	31
(Up to 255 transmission hours based on a nominal 7.5% duty cycle).			
Total Days on Mission	294	Total Days off Mission	71

Annually, each vessel is expected to spend approximately 54 days in transit and 294 days at sea conducting military readiness activities, which includes 240 days of active operations (amounting to 255 transmission hours based on a 7.5% duty cycle). Between missions, an estimated total of 71 days per year will be spent in port for upkeep and repair to maintain both the material condition of the vessel and its systems. The actual number and length of the individual missions within the 240 days are difficult to predict, but the maximum number of actual transmission hours per vessel per year will not exceed 255 hours.

As noted above, this would be the fourth continuous such authorization for the Navy's SURTASS LFA sonar activities. The Navy's current rule and LOA expire after August 14, 2017. Therefore, the Navy has requested MMPA rulemaking and will request annual LOAs for its SURTASS LFA sonar activities effective from August 15, 2017 through August 14, 2022, to take marine mammals incidental to the activities of up to four SURTASS LFA sonar systems. Subsequent LOA applications would be submitted annually throughout the remaining years of the new rule.

Potential SURTASS LFA Sonar Operational Areas

Figure 1 depicts the potential areas of activities for SURTASS LFA sonar. In areas within 12 nmi from any shorelines (coastal exclusion areas) and in areas identified as OBIAs, SURTASS LFA sonar would be operated such that received levels of LFA sonar are below 180 dB re 1 μPa rms sound pressure level (SPL). This restriction would be observed year-round for coastal exclusion areas and during periods of biological importance for OBIAs, but these areas are not depicted in Figure 1 as these areas are not visible at the map scale. Based on the Navy's current operational requirements, potential activities for SURTASS LFA sonar vessels from August 2017 through August 2022 would include areas located in the Pacific, Atlantic, and Indian Oceans as well as the Mediterranean Sea.

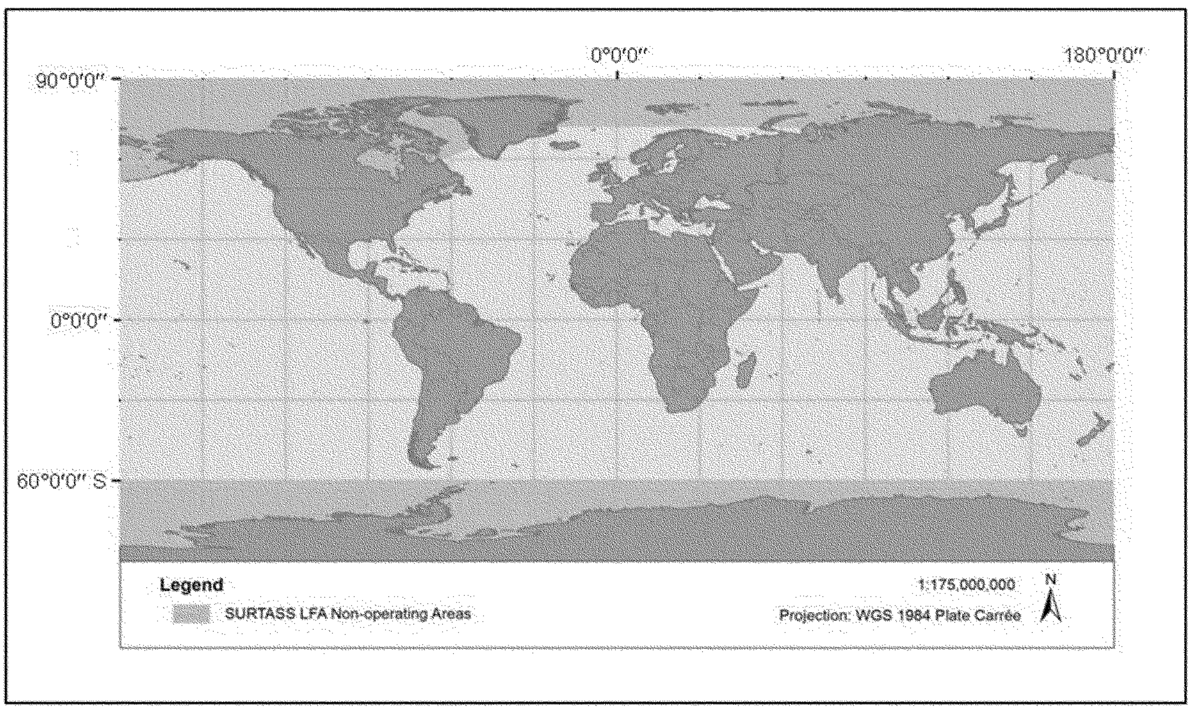

Figure 1. Potential Areas of Operation for SURTASS LFA sonar (DoN, 2011).

The Navy will not operate SURTASS LFA sonar pursuant to this rule in polar regions (*i.e.,* Arctic and Antarctic waters) of the world (see shaded areas in Figure 1). The Arctic Ocean, the Bering Sea (including Bristol Bay and Norton Sound), portions of the Norwegian, Greenland, and Barents Seas north of 72° North (N) latitude, plus Baffin Bay, Hudson Bay, and the Gulf of St. Lawrence would be non-operational areas for SURTASS LFA sonar. In the

Antarctic, the Navy will not conduct SURTASS LFA activities in areas south of 60° South (S) latitude. The Navy has excluded polar waters from operational planning because of the inherent inclement weather conditions and the navigational and operational (equipment) danger that icebergs pose to SURTASS LFA sonar vessels.

The Navy must anticipate, or predict, where they have to operate in the next five years for the MMPA rulemaking. Naval forces are presently operating in several areas strategic to U.S. national and international interests. National security needs may dictate that many of these operational areas will be close to ports and choke points, such as entrances to straits, channels, and canals. It is anticipated that many future naval conflicts are likely to occur within littoral or coastal areas. However, it is infeasible for the Navy to analyze all potential global mission areas for all species and stocks for all seasons. Instead, the Navy projects where it intends to use SURTASS LFA sonar for the next five-year authorization period based on today's political climate and provides NMFS with take estimates for marine mammal stocks in the proposed areas of activity. NMFS believes that this provides sufficient coverage for worldwide SURTASS LFA sonar activities, as specific take numbers are requested on an annual basis in applications for LOAs, subject to an annual cap of 12 percent per stock.

For this fourth rulemaking, the Navy modeled and analyzed 26 representative mission areas in the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea to represent the acoustic regimes and marine mammal species/stocks that may be encountered during worldwide SURTASS LFA sonar activities (see Table 2). They are comprised of the following modeled areas: East of Japan; north Philippine Sea; west Philippine Sea; offshore Guam; Sea of Japan; East China Sea; South China Sea; Offshore Japan (two locations: 25° to 40° N and 10° to 25° N); Hawaii North; Hawaii South; Offshore Southern California; western north Atlantic; eastern North Atlantic; Mediterranean Sea; Arabian Sea; Andaman Sea; Panama Canal; northeast Australia; northwest Australia; northeast of Japan; southern Gulf of Alaska; southern Norwegian Basin (between Iceland and Norway); western North Atlantic (off of Virginia/Maryland); Labrador Sea; and Sea of Okhotsk. Since the Navy cannot forecast the location of its operations, annual requests will be submitted to NMFS that will include specific mission areas and modeling locations for each year's activities. For more details of the impact analysis, see Appendix B in the DSEIS/SOEIS.

TABLE 2—POTENTIAL SURTASS LFA SONAR ACTIVITY AREAS THAT THE NAVY MODELED FOR THE DSEIS/OEIS (DON, 2016a) AND THE MMPA RULEMAKING/LOA APPLICATION

Modeled site	Location (latitude/longitude of center of modeling area)	Modeled site	Location (latitude/longitude of center of modeling area)
East of Japan	38° N., 148° E.	Eastern North Atlantic	56.4° N., 10° W.
North Philippine Sea	29° N., 136° E.	Mediterranean Sea	39° N., 6° E.
West Philippine Sea	22° N., 124° E.	Arabian Sea	14°N., 65° E.
Offshore Guam (Mariana Islands Range Complex, outside Mariana Trench).	11° N., 145° E.	Andaman Sea	7.5° N., 96° E.
Sea of Japan	39° N., 132° E.	Panama Canal	5° N., 81° W.
East China Sea	26° N., 125° E.	Northeast Australia	23° S., 155° E.
South China Sea	14° N., 114° E.	Northwest Australia	18° S., 110° E.
Offshore Japan 25° to 40° N	30° N., 165° E.	Northeast of Japan	52° N., 163° E.
Offshore Japan 10° to 25° N	15° N., 165° E.	Southern Gulf of Alaska	51° N., 150° W.
Hawai'i North	25° N., 158° W.	Southern Norwegian Basin (between Iceland and Norway).	65° N., 0°
Hawaii South	19.5° N., 158.5° W.	Western North Atlantic (off of Virginia/Maryland)	39.6° N., 71.6° W.
Offshore Southern California	32° N., 120° W.	Labrador Sea	57° N., 50° W.
Western North Atlantic (off Florida)	29° N., 76° W.	Sea of Okhotsk	51° N., 150° E.

The use of the SURTASS LFA sonar system during at-sea activities would result in acoustic stimuli from the generation of sound or pressure waves in the water at or above levels that NMFS has determined would result in take of marine mammals under the MMPA. This is the principal means of marine mammal taking associated with these military readiness activities and the Navy has requested authorization to take marine mammals by Level B harassment. At no point are there expected to be more than four systems in use, and thus this proposed rule analyzes the impacts on marine mammals due to the deployment of up to four SURTASS LFA sonar systems for a five-year period between August 2017 and August 2022.

In addition to the use of active acoustic sources, the Navy's activities include the operation and movement of vessels. This document also analyzes the effects of this aspect of the activities. However, NMFS does not anticipate takes of marine mammals to result from ship strikes from any of the four SURTASS LFA vessels because each vessel moves at a relatively slow speed, especially when towing the SURTASS and LFA sonar systems, and for a relatively short period of time. Combined with the use of mitigation measures as noted below, it is likely that any marine mammal would be able to avoid the surveillance vessels.

Detailed Description of the Specified Activities

Description of SURTASS LFA Sonar

SONAR is an acronym for Sound Navigation and Ranging, and its definition includes any system (biological or mechanical) that uses underwater sound, or acoustics, for detection, monitoring, and/or communications. Active sonar is the transmission of sound energy for the purpose of sensing the environment by interpreting features of received signals. Active sonar detects objects by creating a sound pulse, or ''ping'' that is transmitted through the water and reflects off the target, returning in the form of an echo. Passive sonar detects the transmission of sound waves created by an object.

As mentioned previously, the SURTASS LFA sonar system is a long-range, all-weather LF sonar (operating between 100 and 500 Hertz (Hz)) system that has both active and passive components. LFA, the active system component (which allows for the detection of an object that is not generating noise), is comprised of source elements (called projectors) suspended vertically on a cable beneath the surveillance vessel. The projectors produce an active sound pulse by converting electrical energy to mechanical energy by setting up vibrations or pressure disturbances within the water to produce a ping. The Navy uses LFA as an augmentation to the passive SURTASS operations when passive system performance is inadequate. SURTASS, the passive part of the system, uses hydrophones (*i.e.,* underwater microphones) to detect sound emitted or reflected from submerged targets, such as submarines. The SURTASS hydrophones are mounted on a horizontal line array that is towed behind the surveillance vessel. The Navy processes and evaluates the returning signals or echoes, which are usually below background or ambient sound level, to identify and classify potential underwater targets.

LFA Active Component

The active component of the SURTASS LFA sonar system consists of up to 18 projectors suspended beneath the surveillance vessel in a vertical line array. The SURTASS LFA sonar projectors transmit in the low-frequency band (between 100 and 500 Hz). The source level of an individual projector in the SURTASS LFA sonar array is approximately 215 dB re: 1 μPa at 1 m or less (Sound pressure is the sound force per unit area and is usually measured in micropascals (μPa), where one Pascal (Pa) is the pressure resulting from a force of one newton exerted over an area of one square meter. The commonly used reference pressure level in underwater acoustics is 1 μPa at 1 m, and the units for source level are decibels (dB) re: 1 μPa at 1 m). Because of the physics involved in acoustic beamforming (*i.e.,* a method of mapping noise sources by differentiating sound levels based upon the direction from which they originate) and sound transmission loss processes, the SURTASS LFA sonar array cannot have a SPL higher than the SPL of an individual projector.

The SURTASS LFA sonar acoustic transmission is an omnidirectional beam (a full 360 degrees (°)) in the horizontal plane. The LFA sonar system also has a narrow vertical beam that the vessel's crew can steer above or below the horizontal plane. The typical SURTASS LFA sonar signal is not a constant tone, but rather a transmission of various signal types that vary in frequency and duration (including continuous wave (CW) and frequency-modulated (FM) signals). A complete sequence of sound transmissions, also referred to by the Navy as a ''ping'' or a wavetrain, can be as short as six seconds (sec) or last as long as 100 sec, with an average length of 60 sec. Within each ping, the duration of any continuous frequency sound transmission is no longer than 10 sec and the time between pings is typically from six to 15 minutes (min). Based on the Navy's historical operating parameters, the average duty cycle (*i.e.,* the ratio of sound ''on'' time to total time) for LFA sonar is normally 7.5 to 10 percent and the duty cycle is not expected to exceed 20 percent.

Compact LFA Active Component

In addition to the LFA sonar system deployed on the USNS IMPECCABLE, the Navy developed a compact LFA (CLFA) sonar system now deployed on its three smaller surveillance vessels (*i.e.,* the USNS ABLE, EFFECTIVE, and VICTORIOUS). In the application, the Navy indicates that the operational characteristics of the active component CLFA sonar are comparable to the existing LFA systems and that the potential impacts from CLFA will be similar to the effects from the existing LFA sonar system. The CLFA sonar system consists of smaller projectors that weigh 142,000 lbs (64,410 kilograms (kg)), which is 182,000 lbs (82,554 kg) less that the mission weight of the LFA projectors on the USNS IMPECCABLE. The CLFA sonar system also consists of up to 18 projectors suspended beneath the surveillance vessel in a vertical line array and the CLFA sonar projectors transmit in the low-frequency band (also between 100 and 500 Hz) with the same duty cycle as described for LFA sonar. Similar to the active component of the LFA sonar system, the source level of an individual projector in the CLFA sonar array is approximately 215 dB re: 1 μPa or less.

For the analysis in this rulemaking, NMFS will use the term LFA to refer to both the LFA sonar system and/or the CLFA sonar system, unless otherwise specified.

SURTASS Passive Component

The passive component of the SURTASS LFA sonar system consists of a SURTASS Twin-line (TL–29A) horizontal line array mounted with hydrophones. The Y-shaped array is 1,000 ft (305 m) in length and has an operational depth of 500 to 1,500 ft (152.4 to 457.2 m). The SURTASS LFA sonar vessel typically maintains a speed of at least 3.4 mph (5.6 km/hr; 3 knots (kts)) to tow the array astern of the vessel in the correct horizontal configuration.

High-Frequency Active Sonar

Although technically not part of the SURTASS LFA sonar system, the Navy also proposes to use a high-frequency sonar system, called the High Frequency Marine Mammal Monitoring sonar (HF/M3 sonar), to detect and locate marine mammals within the SURTASS LFA sonar activity areas and mitigation and buffer zones, as described later in this proposed rule. This enhanced commercial fish-finding sonar, mounted at the top of the SURTASS LFA sonar vertical line array, has a source level of 220 dB re: 1 μPa at 1 m with a frequency range from 30 to 40 kilohertz (kHz). The duty cycle is variable, but is normally below three to four percent and the maximum pulse duration is 40 milliseconds. The HF/M3 sonar has four transducers with 8° horizontal and 10° vertical beamwidths, which sweep a full 360° in the horizontal plane every 45 to 60 sec with a maximum range of approximately 1.2 mi (2 km).

Vessel Specifications

The Navy proposes to deploy the SURTASS LFA sonar system on a maximum of four U.S. Naval ships: the USNS ABLE (T–AGOS 20), the USNS EFFECTIVE (T–AGOS 21), the USNS IMPECCABLE (T–AGOS 23) and the USNS VICTORIOUS (T–AGOS 19).

The USNS ABLE, EFFECTIVE, and VICTORIOUS, are twin-hulled ocean surveillance ships. Each vessel has a length of 235 feet (ft) (71.6 meters (m)); a beam of 93.6 ft (28.5 m); a maximum draft of 25 ft (7.6 m); and a full load displacement of 3,396 tons (3,451 metric tons). A twin-shaft diesel electric engine provides 3,200 horsepower (hp), which drives two propellers.

The USNS IMPECCABLE, also a twin-hulled ocean surveillance ship, has a length of 281.5 ft (85.8 m); a beam of 95.8 ft (29.2 m); a maximum draft of 26 ft (7.9 m); and a full load displacement of 5,368 tons (5,454 metric tons). A twin-shaft diesel electric engine provides 5,000 hp, which drives two propellers.

The operational speed of each vessel during sonar activities will be approximately 3.4 miles per hour (mph) (5.6 km per hour (km/hr); 3 knots (kt)) and each vessel's cruising speed outside of sonar activities would be a maximum of approximately 11.5 to 14.9 mph (18.5 to 24.1 km/hr; 10 to 13 kts). During sonar activities, the SURTASS LFA sonar vessels will generally travel in straight lines or in oval-shaped (*i.e.,* racetrack) patterns depending on the operational scenario.

Each vessel also has an observation area on the bridge from where lookouts will monitor for marine mammals before and during LFA sonar activities. When stationed on the bridge of the USNS ABLE, EFFECTIVE, or VICTORIOUS, the lookout's eye level will be approximately 32 ft (9.7 m) above sea level providing an unobstructed view around the entire vessel. For the USNS IMPECCABLE, the lookout's eye level will be approximately 45 ft (13.7 m) above sea level.

Notice of Receipt Comments and Responses

On October 21, 2016, NMFS published a notice of receipt (NOR) of an application for rulemaking in the **Federal Register** (81 FR 72782) and requested comments and information from the interested public for 30 days. During the 30-day comment period, which ended on November 21, 2016, NMFS received one comment from an environmental non-governmental organization. This comment stated that the Navy should address several shortcomings in the application such as: (1) Update the information of the impacts of LFA sonar on sensitive federal protected species and their critical habitat; (2) increase the number of offshore biological important areas and expand others to include marine mammal critical habitat; (3) increase current buffer zones to reduce impacts of LFA sonar; (4) update the scientific information of the impact of LFA sonar on marine mammals; (5) provide an analysis of negative effects for information-poor populations; (6) analyze cumulative impacts of LFA sonar, including the synergistic/additive effects of climate change; and (7) include additional mitigation measures to reduce LFA sonar impacts.

The Navy addressed impacts to endangered and threatened species and critical habitat in their application, and the Navy and NMFS' Office of Protected Resources Permits and Conservation Division are currently in consultation with NMFS' Office of Protected Resources ESA Interagency Consultation Division. Consistent with the 1989 preamble for NMFS' implementing regulations (54 FR 40338, September 29, 1989), the impacts from past and ongoing anthropogenic activities are reflected in the environmental baseline (*e.g.,* these impacts are reflected in the density/distribution and status of the species, population size and growth rate, and ambient noise). The reader is also referred to the 2016 DSEIS/SOEIS for more detailed information, including the cumulative impacts and climate change analyses. As noted in the Navy's application, as well as the DSEIS/SOEIS (for which NMFS is a cooperating agency with the Navy for purposes of adopting the DSEIS for this action and in this proposed rule, the number of biologically important areas under consideration have been expanded (commenter noted there are only 22 OBIAs, but there are 28 included in the application and DSEIS/SOEIS). NMFS has addressed the issue of increased buffer zones in previous rulemaking, and it was determined that this was not warranted (see 77 FR 50290, August 20, 2012, Comment 36 Response, and response to comment NRDC–17 of the Navy's 2012 FSEIS/SOEIS for rationale for the additional 1 km buffer). Reanalysis of the matter in this rule confirms this determination. Required buffer zones imposed by NMFS on the Navy's SURTASS LFA sonar include an additional 1 km buffer zone around the Navy's LFA Mitigation Zone and an additional 1 km buffer zone seaward of any OBIA during the time of biological importance. Implementation of the additional 1 km buffer zone will ensure that no marine mammals are exposed to an SPL greater than approximately 174 dB re: 1 μPa, which is below levels for which most marine mammals are anticipated to experience onset of TTS or PTS, and therefore limits potential takes to lower-level Level B behavioral harassment. Lastly, NMFS and Navy evaluated ways to address data-poor scenarios and potential additional mitigation measures as part of the rulemaking process and ongoing adaptive management, which is described in more detail below.

The Marine Mammal Commission (MMC) did not submit comments in response to the NOR, but had previously submitted comments to the Navy and NMFS in response to the Navy's DSEIS/OEIS, and stated that these comments would also suffice as their comments on the Navy's application. The MMC made recommendations to use the best available science plus some measure of uncertainty (*e.g.,* mean plus two standard deviations, mean plus the coefficient of variation, the upper limit of the confidence level) in instances where density data were extrapolated due to data not being available; that the Navy make its Marine Species Density Database (NMSDD) available to the public as soon as possible, specify how density estimates were derived, and what statistic (*e.g.,* mean, median, maximum) was used when multiple sources are referenced; expressed concern regarding the Navy's use of the single ping equivalent (SPE) metric (discussed in more detail below), and recommended that the Navy either use the SPL or sound exposure level (SEL) metric in assessment of behavioral risk from exposure to SURTASS LFA sonar, or use behavior response metrics and thresholds based on Finneran and Jenkins (2012); recommended that the Navy amend its DSEIS/SOEIS to specify the numbers of marine mammals that could be taken by Level A and B harassment incidental to operating SURTASS LFA sonar, rather than providing the percentages of each stock for such takes; requested further clarification in regard to whether there were zero Level A takes modeled, or if Level A takes were reduced to zero with mitigation applied; and expressed agreement with the proposed expansion of five OBIAs and the addition of six new OBIAs, but requested additional information on the evaluation for determining that other areas did not meet the criteria for designation as OBIAs.

Regarding the NMSDD, all data sources that go into the database are cited so they can be obtained. Some of the data sources are proprietary, so the Navy is unable to provide the NMSDD in GIS shapefile format because they only have a license for the Navy. NMFS notes that the single ping equivalent (SPE) has been used in each of the previous rulemakings and NMFS continues to believe the use of this metric is appropriate for assessing behavioral responses for SURTASS LFA sonar because it is a conservative estimate that accounts for the increased potential for behavioral responses due to repeated exposures by adding 5 x log10 (number of pings) to each 1-dB received level (RL) increment, and sums these across all dB levels to determine the dB SPE for each modeled animal (*i.e.,* SPE is a cumulative metric which accounts for not only the level of exposure but also the duration of exposure). The behavior response data used to derive Finneran and Jenkins (2012) thresholds were from mid-frequency sources, while the data used to derive the behavioral thresholds for SURTASS LFA were specifically from studies using the actual source. Therefore, NMFS feels they are more appropriate to apply to SURTASS LFA sonar. Also, as in previous rulemakings, the proposed rule does not specify the number of marine mammals that may be taken in the proposed locations because these numbers are determined annually through various inputs such as mission location, mission duration, and season of operation. As with previous rulemakings, this proposed rule analyzes a maximum of 12 percent takes by Level B harassment per stock annually, and the Navy will use the 12 percent limit to guide its mission planning and annual LOA applications as described in more detail below. We also note that the analysis for this rulemaking used the updated thresholds per the NMFS 2016 Acoustic Technical Guidance, and based on this analysis, NMFS and the Navy believe that it is unlikely that Level A Harassment takes are likely to occur, and therefore none are proposed to be authorized. Lastly, in regard to OBIAs, we continue to work with the Navy in reviewing and analyzing OBIAs as part of adaptive management. As described in the 2012 rulemaking as well as the Navy's 2016 application and DSEIS/SOEIS, as new information becomes available, areas are re-evaluated to determine if any areas should be added or expanded. NMFS has also evaluated the recommendations in a white paper written by NMFS scientists (discussed in detail below).

Description of Marine Mammals in the Area of the Specified Activities

One hundred and four (104) currently classified marine mammal species or stocks have confirmed or possible occurrence within potential SURTASS LFA activity areas in certain areas of the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea. Fifteen (15) species of baleen whales (mysticetes), 60 species of toothed whales, dolphins, or porpoises (odontocetes), and 29 species of seals or sea lions (pinnipeds) could be affected by SURTASS LFA sonar activities. Multiple stocks of some species are affected, and independent assessments are conducted to make the necessary findings and determinations for each of these.

There are 20 marine mammal species under NMFS' jurisdiction that are listed as endangered or threatened under the Endangered Species Act (ESA; 16 U.S.C. 1531 *et seq.*) with confirmed or possible occurrence in potential activity areas for SURTASS LFA sonar. Marine mammal species under NMFS' jurisdiction listed as endangered include: The blue whale (*Balaenoptera musculus*); fin whale (*Balaenoptera physalus*); sei whale (*Balaenoptera borealis*); the Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, and Western North Pacific distinct population segments (DPS) of humpback whale (*Megaptera novaeangliae*); bowhead whale (*Balaena mysticetus*); North Atlantic right whale (*Eubalaena glacialis*); North Pacific right whale (*Eubalaena japonica*); southern right whale (*Eubalaena australis*); Western North Pacific population of gray whale (*Eschrichtius robustus*); sperm whale (*Physeter macrocephalus*); the Cook Inlet stock of beluga whale (*Delphinapterus leucas*); the main Hawaiian Islands Insular DPS of false killer whale (*Psuedorca crassidens*); the Southern Resident population of Killer whale (*Orca orcinus*); the Western DPS of the Steller sea lion (*Eumetopias jubatus*); Mediterranean monk seal (*Monachus monachus*); and Hawaiian monk seal (*Monachus schauinslandi*). Marine mammal species under NMFS' jurisdiction listed as threatened include: The Guadalupe fur seal (*Arctocephalus townsendi*); the Okhotsk ringed seal (*Pusa hispida ochotensis*); the Okhotsk DPS of Pacific bearded seal (*Erignathus barbatus nauticus*); the southern DPS of the spotted seal (*Phoca largha*); and the Mexico DPS of humpback whale (*Megaptera novaeangliae*). Additionally, the Gulf of Mexico subspecies of the Bryde's whale has recently been proposed for listing under the ESA as endangered. The aforementioned threatened and endangered marine mammal species also are depleted under the MMPA.

Three of the 104 species or stocks with potential occurrences within possible SURTASS LFA activity areas are considered depleted under the MMPA but are not ESA-listed. They are: The Eastern (Loughlin's) Steller sea lion (*Eumetopias jubatus monteriensis*); the Pribilof Island/Eastern Pacific stock of northern fur seal (*Callorhinus ursinus*); and the arctic ringed seal (*Pusa hispida hispida*).

Chinese river dolphins (*Lipotes vexillifer*) and vaquita (*Phocoena sinus*) do not have stocks designated within potential SURTASS LFA sonar operational areas (see Potential SURTASS LFA Operational Areas section). The distribution of the Chinese river dolphin is limited to the main channel of a river section between the cities of Jingzhou and Jiangyin. The vaquita's distribution is restricted to the upper portion of the northern Gulf of California, mostly within the Colorado River delta. Based on the extremely rare occurrence of these species in the Navy's operational areas and coastal standoff range (*i.e.,* distance of 22 km (13 mi; 12 nmi) from land), take of Chinese river dolphins or vaquita is not considered a reasonable likelihood; therefore these species are not addressed further in this document.

The U.S. Fish and Wildlife Service (USFWS) is responsible for managing the following marine mammal species: Southern sea otter (*Enhydra lutris*), polar bear (*Ursus maritimus*), walrus (*Odobenus rosmarus*), west African manatee (*Trichechus senegalensis*), Amazonian manatee (*Trichechus inunguis*), west Indian manatee (*Trichechus manatus*), and dugong (*Dugong dugon*). None of these species occur in geographic areas that would overlap with SURTASS LFA sonar operational areas. Therefore, the Navy has determined that SURTASS LFA sonar activities would have no effect on the endangered or threatened species or the critical habitat of the ESA-listed species under the jurisdiction of the USFWS. These species are not considered further in this notice.

Tables 3 through 28 (below) summarize the abundance, status under the ESA, and density estimates of the marine mammal species and stocks that have confirmed or possible occurrence within 26 SURTASS LFA sonar operating areas in the Pacific, Indian, and Atlantic Oceans and Mediterranean Sea. To accurately assess the potential effects of worldwide SURTASS LFA sonar activities, the Navy modeled 26 representative sites based on the Navy's current assessment of current and future requirements or threats.

TABLE 3—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 1, THE SEA OF JAPAN

[Summer season]

Species	Stock name [1]	Stock abundance [2]	Density (animals/km²) [3]	ESA status [4]
Blue whale	WNP	9,250	[5] NA	EN
Fin whale	WNP	9,250	0.0002	EN
Sei whale	NP	7,000	0.0006	EN

TABLE 3—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 1, THE SEA OF JAPAN—Continued

[Summer season]

Species	Stock name [1]	Stock abundance [2]	Density (animals/km²) [3]	ESA status [4]
Bryde's whale	WNP	20,501	0.0006	NL
Minke whale	WNP "O" Stock	25,049	0.0022	NL
North Pacific right whale	WNP	922	NA	EN
Humpback whale	WNP	1,328	0.00036	EN
Sperm whale	NP	102,112	0.00123	EN
Harbor porpoise	WNP	31,046	0.0190	NL
Baird's beaked whale	WNP	8,000	0.0029	NL
Cuvier's beaked whale	WNP	90,725	0.0031	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
Hubbs beaked whale	NP	22,799	0.0005	NL
False killer whale	WNP—Pelagic	16,668	0.0036	NL
Pygmy killer whale	WNP	30,214	0.0021	NL
Short-finned pilot whale	WNP	53,608	0.0128	NL
Risso's dolphin	WNP	83,289	0.0097	NL
Short-beaked common dolphin	WNP	3,286,163	0.0761	NL
Killer whale	WNP	12,256	0.0001	NL
Common bottlenose dolphin	WNP	168,791	0.0171	NL
Pantropical spotted dolphin	WNP	438,064	0.0259	NL
Striped dolphin	WNP	570,038	0.0111	NL
Spinner dolphin	WNP	1,015,059	0.00083	NL
Pacific white-sided dolphin	NP	931,000	0.0082	NL
Rough-toothed dolphin	WNP	145,729	0.0059	NL
Kogia spp	WNP	350,553	0.0031	NL
Stejneger's beaked whale	WNP	8,000	0.0005	NL

[1] NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 4—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 2, NORTH PHILIPPINE SEA OPERATIONAL AREA

[Fall season]

Species	Stock name [1]	Abundance [2]	Density (animals/Km²) [3]	ESA status [4]
Bryde's whale	WNP	20,501	0.0006	NL
Minke whale	WNP "O" Stock	25,049	0.0044	NL
North Pacific right whale	WNP	922	[5] NA	EN
Blue whale	WNP	9,250	.00001	EN
Fin whale	WNP	9,250	NA	EN
Humpback whale	WNP	1,328	.00089	EN
Omura's whale	WNP	1,800	.00006	NL
Sperm whale	NP	102,112	0.00123	EN
Common bottlenose dolphin	WNP	168,791	0.0146	NL
Cuvier's beaked whale	WNP	90,725	0.0054	NL
Blainville's beaked whale	WNP	8,032	0.0005	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
Killer whale	WNP	12,256	0.00009	NL
False killer whale	WNP—Pelagic	16,668	0.0029	NL
Pygmy killer whale	WNP	30,214	0.0021	NL
Melon-headed whale	WNP	36,770	0.00428	NL
Short-finned pilot whale	WNP	53,608	0.0153	NL
Risso's dolphin	WNP	83,289	0.0106	NL
Short-beaked common dolphin	WNP	3,286,163	0.0562	NL
Fraser's dolphin	WNP	220,789	0.0069	NL
Kogia spp	WNP	350,553	0.0031	*
Long-beaked common dolphin	WNP	279,182	0.1158	NL
Longman's beaked whale	WNP	4,571	0.00025	NL
Pantropical spotted dolphin	WNP	438,064	0.0137	NL
Striped dolphin	WNP	570,038	0.0329	NL
Spinner dolphin	WNP	1,015,059	0.00083	NL
Pacific white-sided dolphin	NP	931,000	NA	NL
Rough-toothed dolphin	WNP	145,729	0.0059	NL

[1] NP = north Pacific; WNP = western north Pacific.

[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 5—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 3, WEST PHILIPPINE SEA OPERATIONAL AREA

[Fall season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Blue whale	WNP	9,250	.00001	EN
Bryde's whale	WNP	20,501	0.0006	NL
Minke whale	WNP "O" Stock	25,049	0.0033	NL
Fin whale	WNP	9,250	[5] NA	EN
Humpback whale	WNP	1,328	0.00089	EN
Omura's whale	WNP	1,800	0.00006	NL
Sperm whale	NP	102,112	0.00123	EN
Killer whale	WNP	12,256	0.00009	NL
Cuvier's beaked whale	WNP	90,725	0.0003	NL
Blainville's beaked whale	WNP	8,032	0.0005	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
False killer whale	WNP—Pelagic	16,668	0.0029	NL
Pygmy killer whale	WNP	30,214	0.0021	NL
Melon-headed whale	WNP	36,770	0.00428	NL
Short-finned pilot whale	WNP	53,608	0.0076	NL
Risso's dolphin	WNP	83,289	0.0106	NL
Kogia spp	WNP	350,553	0.0017	*
Fraser's dolphin	WNP	220,789	0.0069	NL
Common bottlenose dolphin	WNP	168,791	0.0146	NL
Deraniyagala's beaked whale	NP	22,799	0.0005	NL
Pantropical spotted dolphin	WNP	438,064	0.0137	NL
Striped dolphin	WNP	570,038	0.0164	NL
Spinner dolphin	WNP	1,015,059	0.00083	NL
Rough-toothed dolphin	WNP	145,729	0.0059	NL
Long-beaked common dolphin	WNP	279,182	0.1158	NL
Longman's beaked whale	WNP	4,571	0.00025	NL

[1] NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 6—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 4, OFFSHORE GUAM

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Blue whale	WNP	9,250	NA [5]	EN
Fin whale	WNP	9,250	NA	EN
Sei whale	NP	7,000	NA	EN
Bryde's whale	WNP	20,501	0.0004	NL
Minke whale	WNP "O" Stock	25,049	NA	NL
Humpback whale	WNP	1,328	NA	EN
Omura's whale	WNP	1,800	0.00004	NL
Sperm whale	NP	102,112	0.00123	EN
Pygmy sperm whale	WNP	350,553	0.00291	NL
Dwarf sperm whale	WNP	350,553	0.00714	NL
Cuvier's beaked whale	WNP	90,725	0.00079	NL
Blainville's beaked whale	WNP	8,032	0.001	NL
Ginkgo-toothed beaked whale	NP	22,799	0.00093	NL
Longman's beaked whale	WNP	4,571	0.0019	NL
Killer whale	WNP	12,256	0.00014	NL
False killer whale	WNP—Pelagic	16,668	0.00111	NL
Pygmy killer whale	WNP	30,214	0.00014	NL
Melon-headed whale	NMI	2,455	0.00428	NL
Short-finned pilot whale	WNP	53,608	0.0051	NL
Risso's dolphin	WNP	83,289	0.003	NL
Deraniyagala's beaked whale	NP	22,799	0.00093	NL
Fraser's dolphin	CNP	16,992	0.0069	NL

TABLE 6—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 4, OFFSHORE GUAM—Continued

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Common bottlenose dolphin	WNP	168,791	0.00245	NL
Pantropical spotted dolphin	WNP	438,064	0.0226	NL
Striped dolphin	WNP	570,038	0.00616	NL
Spinner dolphin	WNP	1,015,059	0.00083	NL
Rough-toothed dolphin	WNP	145,729	0.0026	NL

[1] CNP = central north Pacific; NP = north Pacific; WNP = western north Pacific; NMI = Northern Mariana Islands.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 7—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 5, SEA OF JAPAN

[Fall season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Fin whale	WNP	9,250	0.0009	EN
Bryde's whale	WNP	20,501	0.0001	NL
Minke whale	WNP "O" Stock	25,049	0.0004	NL
Minke whale	WNP "J" Stock	893	0.00016	NL
North Pacific right whale	WNP	922	[5] NA	EN
Gray whale	WNP	140	0.00001	EN [6]
Omura's whale	WNP	1,800	0.00001	NL
Sperm whale	NP	102,112	0.00123	EN
Stejneger's beaked whale	WNP	8,000	0.0005	NL
Baird's beaked whale	WNP	8,000	0.0003	NL
Cuvier's beaked whale	WNP	90,725	0.0031	NL
Harbor porpoise	WNP	31,046	0.0190	NL
False killer whale	IA-Pelagic	9,777	0.0027	NL
Killer whale	WNP	12,256	0.00009	NL
Short-finned pilot whale	WNP	53,608	0.0014	NL
Risso's dolphin	IA	83,289	0.0073	NL
Short-beaked common dolphin	WNP	3,286,163	0.0860	NL
Common bottlenose dolphin	IA	105,138	0.00077	NL
Kogia spp	WNP	350,553	0.0017	*
Spinner dolphin	WNP	1,015,059	0.00083	NL
Pacific white-sided dolphin	NP	931,000	NA	NL
Dall's porpoise	SOJ	173,638	0.0520	NL
Long-beaked common dolphin	WNP	279,182	0.1158	NL
Rough-toothed dolphin	WNP	145,729	0.0026	NL
Striped dolphin	IA	570,038	0.00584	NL
Spotted seal	Southern stock	3,500	0.00001	T

[1] IA = Inshore Archipelago; NP = north Pacific; SOJ = Sea of Japan; WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.
[6] Only the western Pacific population of gray whale is endangered under the ESA.

TABLE 8—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 6, EAST CHINA SEA

[Summer season]

Species	Stock Name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Fin whale	ECS	500	0.0002	EN
Bryde's whale	ECS	137	0.0003	NL
Minke whale	WNP "O" Stock	25,049	0.0044	NL
Minke whale	WNP "J" Stock	893	0.0018	NL
North Pacific right whale	WNP	922	[5] NA	EN
Gray whale	WNP	140	NA	EN [6]
Omura's whale	WNP	1,800	0.00003	NL

TABLE 8—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 6, EAST CHINA SEA—Continued

[Summer season]

Species	Stock Name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Sperm whale	NP	102,112	0.00123	EN
Cuvier's beaked whale	WNP	90,725	0.0003	NL
Blainville's beaked whale	WNP	8,032	0.0005	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
False killer whale	IA-Pelagic	9,777	0.00111	NL
Pygmy killer whale	WNP	30,214	0.00014	NL
Melon-headed whale	WNP	36,770	0.00428	NL
Short-finned pilot whale	WNP	53,608	0.0016	NL
Risso's dolphin	IA	83,289	0.0106	NL
Short-beaked common dolphin	WNP	3,286,163	0.0461	NL
Fraser's dolphin	WNP	220,789	0.00694	NL
Common bottlenose dolphin	IA	105,138	0.00077	NL
Pantropical spotted dolphin	WNP	219,032	0.01374	NL
Striped dolphin	IA	570,038	0.00584	NL
Spinner dolphin	WNP	1,015,059	0.00083	NL
Pacific white-sided dolphin	NP	931,000	NA	NL
Rough-toothed dolphin	WNP	145,729	0.0026	NL
Killer whale	WNP	12,256	0.00009	NL
Kogia spp	WNP	350,553	0.0017	*
Long-beaked common dolphin	WNP	279,182	0.1158	NL
Longman's beaked whale	WNP	4,571	0.00025	NL
Spotted seal	Southern stock	1,000	0.00001	T

[1] ECS = East China Sea; IA = Inshore Archipelago; NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.
[6] Only the western Pacific population of gray whale is endangered under the ESA.

TABLE 9—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 7, SOUTH CHINA SEA

[Fall season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Fin whale	WNP	9,250	0.0002	EN
Bryde's whale	WNP	20,501	0.0006	NL
Minke whale	WNP "O" Stock	25,049	0.0033	NL
Minke whale	WNP "J" Stock	893	0.0018	NL
Humpback whale	WNP	1,328	0.00036	EN
North Pacific right whale	WNP	922	[5] NA	EN
Omura's whale	WNP	1,800	0. 00006	NL
Gray whale	WNP	140	0.00001	EN [6]
Sperm whale	NP	102,112	0.0012	EN
Long-beaked common dolphin	WNP	279,182	0.1158	NL
Cuvier's beaked whale	WNP	90,725	0.0003	NL
Blainville's beaked whale	WNP	8,032	0.0005	NL
Ginkgo-toothed beaked whale	NP	22,799	0.0005	NL
False killer whale	IA-Pelagic	9,777	0.00111	NL
Pygmy killer whale	WNP	30,214	0.00014	NL
Melon-headed whale	WNP	36,770	0.00428	NL
Short-finned pilot whale	WNP	53,608	0.00159	NL
Risso's dolphin	IA	83,289	0.0106	NL
Longman's beaked whale	WNP	4,571	0.00025	NL
Fraser's dolphin	WNP	220,789	0.00694	NL
Common bottlenose dolphin	IA	105,138	0.00077	NL
Pantropical spotted dolphin	WNP	219,032	0.01374	NL
Striped dolphin	IA	570,038	0.00584	NL
Spinner dolphin	WNP	1,015,059	0.00083	NL
Rough-toothed dolphin	WNP	145,729	0.0026	NL
Deraniyagala's beaked whale	NP	22,799	0.0005	NL
Killer whale	WNP	12,256	0.00009	NL
Kogia spp	WNP	350,553	0.0017	*

[1] IA = Inshore Archipelago; NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.

[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.
[6] Only the western Pacific population of gray whale is endangered under the ESA.

TABLE 10—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 8, OFFSHORE JAPAN 25° TO 40° N.

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Blue whale	WNP	9,250	[5]NA	EN
Fin whale	WNP	9,250	0.0001	EN
Sei whale	NP	7,000	0.00029	EN
Bryde's whale	WNP	20,501	0.00041	NL
Minke whale	WNP "O" Stock	25,049	0.0003	NL
Humpback whale	WNP	1,328	0.00036	EN
Sperm whale	NP	102,112	0.0022	EN
Pygmy sperm whale	WNP	350,553	0.0018	NL
Dwarf sperm whale	WNP	350,553	0.0043	NL
Northern right whale dolphin	NP	68,000	NA	NL
Blainville's beaked whale	WNP	8,032	0.0007	NL
Hubb's beaked whale	NP	22,799	0.0005	NL
Killer whale	WNP	12,296	0.00009	NL
Longman's beaked whale	WNP	4,571	0.0003	NL
Baird's beaked whale	WNP	8,000	0.0001	NL
Cuvier's beaked whale	NP	90,725	0.00374	NL
Mesoplodon spp	WNP	22,799	0.0005	NL
False killer whale	WNP-Pelagic	16,668	0.0036	NL
Pygmy killer whale	WNP	30,214	0.0001	NL
Melon-headed whale	WNP	36,770	0.0027	NL
Short-finned pilot whale	WNP	53,608	0.0021	NL
Risso's dolphin	WNP	83,289	0.0005	NL
Short-beaked common dolphin	WNP	3,286,163	0.0863	NL
Common bottlenose dolphin	WNP	168,791	0.00077	NL
Pantropical spotted dolphin	WNP	438,064	0.0113	NL
Striped dolphin	WNP	570,038	0.0058	NL
Spinner dolphin	WNP	1,015,059	0.0019	NL
Pacific white-sided dolphin	NP	931,000	0.0048	NL
Rough-toothed dolphin	WNP	145,729	0.0019	NL
Stejneger's beaked whale	WNP	8,000	0.0005	NL
Hawaiian monk seal	Hawaii	1,400	0.00001	EN
Northern fur seal	Western Pacific	503,609	NA	NL

[1] NP = north Pacific; WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 11—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 9, OFFSHORE JAPAN 10° TO 25° N.

[Winter season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Blue whale	WNP	9,250	0.00001	EN
Bryde's whale	WNP	20,501	0.0003	NL
Fin whale	WNP	9,250	0.00001	EN
Humpback whale	WNP	1,328	0.00036	EN
Omura's whale	WNP	1,800	0.00003	NL
Sei whale	NP	7,000	0.0029	EN
Sperm whale	NP	102,112	0.00222	EN
Pygmy sperm whale	WNP	350,553	0.00176	NL
Dwarf sperm whale	WNP	350,553	0.0043	NL
Cuvier's beaked whale	WNP	90,725	0.00374	NL
False killer whale	WNP	16,668	0.00057	NL
Melon-headed whale	WNP	36,770	0.00267	NL
Short-finned pilot whale	WNP	53,608	0.00211	NL
Risso's dolphin	WNP	83,289	0.00046	NL
Pygmy killer whale	WNP	30,214	0.00006	NL
Common bottlenose dolphin	WNP	168,791	0.00077	NL

TABLE 11—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 9, OFFSHORE JAPAN 10° TO 25° N.—Continued

[Winter season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Pantropical spotted dolphin	WNP	438,064	0.01132	NL
Striped dolphin	WNP	570,038	0.00584	NL
Spinner dolphin	WNP	1,015,059	0.00187	NL
Rough-toothed dolphin	WNP	145,729	0.00185	NL
Blainville's beaked whale	WNP	8,032	0.0007	NL
Deraniyagala's beaked whale	NP	22,799	0.00093	NL
Fraser's dolphin	CNP	16,992	0.00251	NL
Ginkgo-toothed beaked whale	NP	22,799	0.00093	NL
Killer whale	WNP	12,256	0.00009	NL
Longman's beaked whale	WNP	4,571	0.00025	NL

[1] NP = north Pacific; CNP = central north Pacific; WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 12—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 10, NORTHERN HAWAII

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Blue whale	CNP	81	[5]NA	EN
Bryde's whale	Hawaii	798	0.0003	NL
Common minke whale	Hawaii	25,049	NA	NL
Humpback whale	Hawaii DPS	10,103	NA	NL
Fin whale	Hawaii	58	NA	EN
Sei whale	Hawaii	178	NA	EN
Sperm whale	Hawaii	3,354	0.0014	EN
Pygmy sperm	Hawaii	7,138	0.0029	NL
Dwarf sperm whale	Hawaii	17,519	0.00714	NL
Cuvier's beaked whale	Hawaii	1,941	0.0008	NL
Blainville's beaked whale	Hawaii	2,338	0.001	NL
Longman's beaked whale	Hawaii	4,571	0.0019	NL
Killer whale	Hawaii	101	0.00004	NL
False killer whale	Hawaii-Pelagic	1,540	0.0006	NL
False killer whale	Main Hawaiian Islands Insular	151	0.0012	EN
False killer whale	Northwestern Hawaiian Islands	617	0.0013	NL
Pygmy killer whale	Hawaii	3,433	0.0014	NL
Melon-headed whale	Hawaiian Islands	5,794	0.0012	NL
Melon-headed whale	Kohala Resident	447	0.03725	NL
Short-finned pilot whale	Hawaii	12,422	0.0051	NL
Risso's dolphin	Hawaii	7,256	0.003	NL
Fraser's dolphin	Hawaii	16,992	0.0069	NL
Common bottlenose dolphin	Hawaii pelagic	5,950	0.0025	NL
Common bottlenose dolphin	Kauai/Niihau	184	0.0001	NL
Common bottlenose dolphin	4 Islands	191	0.0001	NL
Common bottlenose dolphin	Oahu	743	0.0003	NL
Common bottlenose dolphin	Hawaii Island	128	0.0001	NL
Pantropical spotted dolphin	Hawaiian Pelagic	15,917	0.0067	NL
Pantropical spotted dolphin	Hawaiian Island	220	0.0067	NL
Pantropical spotted dolphin	Oahu	220	0.0067	NL
Pantropical spotted dolphin	4 Islands	220	0.0067	NL
Striped dolphin	Hawaii	20,650	0.0084	NL
Spinner dolphin	Hawaii Pelagic	3,351	0.0008	NL
Spinner dolphin	Kauai/Nihau	601	0.007	NL
Spinner dolphin	Hawaiian Island	631	0.007	NL
Spinner dolphin	Oahu/4 Islands	355	0.007	NL
Spinner dolphin	Kure/Midway Atoll	260	0.007	NL
Spinner dolphin	Pearl and Hermes Reef	300	0.007	NL
Rough-toothed dolphin	Hawaii	6,288	0.0026	NL
Hawaiian monk seal	Hawaii	1,112	0.00001	EN

[1] CNP = central north Pacific; WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 13—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 11, SOUTHERN HAWAII

[Fall season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Blue whale	CNP	81	0.00003	EN
Fin whale	Hawaii	58	0.00002	EN
Bryde's whale	Hawaii	798	0.0003	NL
Common minke whale	Hawaii	25,049	0.0002	NL
Humpback whale	Hawaii DPS	10,103	0.00089	NL
Sei whale	Hawaii	178	0.0001	EN
Sperm whale	Hawaii	3,354	0.0014	EN
Pygmy sperm whale	Hawaii	7,138	0.0029	NL
Blainville's beaked whale	Hawaii	2,338	0.001	NL
Longman's beaked whale	Hawaii	4,571	0.0019	NL
Killer whale	Hawaii	101	0.00004	NL
False killer whale	Hawaii-Pelagic	1,540	0.0006	NL
False killer whale	Main Hawaiian Island Insular	151	0.0012	EN
Pygmy killer whale	Hawaii	3,433	0.0014	NL
Melon-headed whale	Hawaiian Islands	5,794	0.0012	NL
Melon-headed whale	Kohala Resident	447	0.03725	NL
Short-finned pilot whale	Hawaii	12,422	0.0051	NL
Risso's dolphin	Hawaii	7,256	0.003	NL
Fraser's dolphin	Hawaii	16,992	0.0069	NL
Common bottlenose dolphin	Hawaii Pelagic	5,950	0.00245	NL
Common bottlenose dolphin	Kauai/Niihau	184	0.0001	NL
Common bottlenose dolphin	4 Islands	191	0.0001	NL
Common bottlenose dolphin	Oahu	743	0.0003	NL
Common bottlenose dolphin	Hawaii Island	128	0.0001	NL
Pantropical spotted dolphin	Hawaiian Pelagic	15,917	0.0067	NL
Pantropical spotted dolphin	Hawaii Island	220	0.0067	NL
Pantropical spotted dolphin	Oahu	220	0.0067	NL
Pantropical spotted dolphin	4 Islands	220	0.0067	NL
Striped dolphin	Hawaii	20,650	0.0084	NL
Spinner dolphin	Hawaii Pelagic	3,351	0.0008	NL
Spinner dolphin	Kauai/Niihau	601	0.007	NL
Spinner dolphin	Hawaii Island	631	0.007	NL
Spinner dolphin	Oahu/4 Islands	355	0.007	NL
Rough toothed dolphin	Hawaii	6,288	0.0026	NL
Cuvier's beaked whale	Hawaii	1,914	0.0008	NL
Deraniyagala's beaked whale	NP	22,799	0.00093	NL
Dwarf sperm whale	Hawaii	17,519	0.00714	NL
Hawaiian monk seal	Hawaii	1,400	0.00001	EN

[1] CNP = central north Pacific; WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 14—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 12, OFFSHORE SOUTHERN CALIFORNIA

[Spring season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Blue whale	ENP	1,647	0.00011	EN
Fin whale	CA/OR/WA	3,051	0.00022	EN
Sei whale	ENP	126	0.00009	EN
Bryde's whale	ENP	13,000	0.00001	NL
Common minke whale	CA/OR/WA	478	0.00026	NL
Humpback whale	Mexico DPS	1,918	0.00121	T
Gray whale	ENP	20,990	0.03090	NL
Gray whale	WNP	140	0.00001	EN [5]
Sperm whale	CA/OR/WA	2,106	0.00337	EN
Pygmy sperm whale	CA/OR/WA	579	0.00108	NL
Stejneger's beaked whale	CA/OR/WA	694	0.00065	NL
Baird's beaked whale	CA/OR/WA	847	0.00046	NL
Cuvier's beaked whale	CA/OR/WA	6,590	0.00358	NL
Blainville's beaked whale	CA/OR/WA	694	0.00101	NL
Ginkgo-toothed beaked whale	CA/OR/WA	694	0.00020	NL
Hubbs beaked whale	CA/OR/WA	694	0.00086	NL
Striped dolphin	CA/OR/WA	10,908	0.02592	NL

TABLE 14—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 12, OFFSHORE SOUTHERN CALIFORNIA—Continued

[Spring season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Perrin's beaked whale	CA/OR/WA	694	0.00088	NL
Pygmy beaked whale	CA/OR/WA	694	0.00020	NL
Killer whale (offshore)	EP	240	0.00030	NL
Short-finned pilot whale	CA/OR/WA	760	0.00031	NL
Risso's dolphin	CA/OR/WA	6,272	0.0100	NL
Long-beaked common dolphin	CA	107,016	0.08591	NL
Short-beaked common dolphin	CA/OR/WA	411,211	0.95146	NL
Common bottlenose dolphin (offshore)	CA/OR/WA	1,006	0.01230	NL
Pacific white-sided dolphin	CA/OR/WA	26,930	0.21549	NL
Northern right whale dolphin	CA/OR/WA	21,332	0.13352	NL
Dall's porpoise	CA/OR/WA	42,000	0.02184	NL
Guadalupe fur seal	Mexico	7,408	0.00387	T
Northern fur seal	California	14,050	0.01775	NL
California sea lion	US (Pacific Temperate)	296,750	0.33596	NL
Harbor seal	California	30,968	0.02033	NL
Northern elephant seal	CA-Breeding	179,000	0.03222	NL

[1] CA/OR/WA = California, Oregon, and Washington; ENP = eastern north Pacific; EP = eastern Pacific; WNP = western north Pacific; SMI = San Miguel Island.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] Only the western Pacific population of gray whale is endangered under the ESA.

TABLE 15—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 13, WESTERN NORTH ATLANTIC OFF FLORIDA

[Winter season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Humpback whale	West Indies DPS	12,132	0.00004	NL
Common minke whale	Canadian East Coast	20,174	0.00230	NL
North Atlantic right whale	WNA	476	0.00002	EN
Sperm whale	WNA	2,288	0.00083	EN
Mesoplodon spp.	WNA	7,092	0.00180	NL
Kogia spp.	WNA	3,785	0.00094	NL
Cuvier's beaked whale	WNA	6,532	0.00166	NL
Common bottlenose dolphin	Offshore WNA	77,532	0.04195	NL
Common bottlenose dolphin	Southern Migratory Coast	9,173	0.00155	NL
Common bottlenose dolphin	Northern FL Coast	1,219	0.00155	NL
Common bottlenose dolphin	Central FL Coast	4,895	0.00155	NL
Short-finned pilot whale	WNA	21,515	0.00616	NL
Risso's dolphin	WNA	18,250	0.00411	NL
False killer whale	WNA	442	0.00008	NL
Killer whale	WNA	67	0.00001	NL
Short-beaked common dolphin	WNA	173,486	0.00125	NL
Pantropical spotted dolphin	WNA	3,333	0.00608	NL
Striped dolphin	WNA	54,807	0.00298	NL
Atlantic spotted dolphin	WNA	44,715	0.01143	NL
Spinner dolphin	WNA	262	0.00040	NL
Clymene dolphin (*Stenella clymene*)	WNA	6,086	0.02522	NL
Rough-toothed dolphin	WNA	271	0.00069	NL

[1] WNA = western north Atlantic.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 16—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 14, NORTHEASTERN ATLANTIC

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Blue whale	ENA	979	0.00002	EN
Fin whale	ENA	9,019	0.00100	EN
Sei whale	Iceland-Denmark Strait	10,300	0.00040	EN

TABLE 16—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 14, NORTHEASTERN ATLANTIC—Continued

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Common minke whale	Northeast Atlantic	78,572	0.00329	NL
Humpback whale	Cape Verdes and West Africa DPS.	11,572	0.00009	EN
Sperm whale	ENA	7,785	0.00077	EN
Cuvier's beaked whale	ENA	6,992	0.00700	NL
Gervais' beaked whale	ENA	6,992	0.00700	NL
Blainville's beaked whale	ENA	6,992	0.00700	NL
Sowerby's beaked whale	ENA	6,992	0.00700	NL
Northern bottlenose whale	ENA	19,538	0.00260	NL
Killer whale	Northern Norway	731	0.00001	NL
Kogia spp.	ENA	3,785	0.00079	NL
Long-finned pilot whale	ENA	128,093	0.05400	NL
Risso's dolphin	ENA	18,250	0.00200	NL
Short-beaked common dolphin	ENA	172,930	0.01000	NL
Common bottlenose dolphin	ENA	35,780	0.00200	NL
Striped dolphin	ENA	67,414	0.00150	NL
True's beaked whale	ENA	6,992	0.00700	NL
Atlantic white-sided dolphin	ENA	3,904	0.00001	NL
White-beaked dolphin	ENA	16,536	0.01400	NL
Harbor porpoise	ENA	375,358	0.07400	NL
Harbor seal	NW Europe	40,414	0.04000	NL
Gray seal	NW Europe	116,800	0.00040	NL

[1] ENA = eastern north Atlantic.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 17—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 15, MEDITERRANEAN SEA

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Fin whale	MED	3,583	0.00168	EN
Cuvier's beaked whale	Alboran Sea	429	0.000108	NL
Long-finned pilot whale	ENA	21,515	0.0027	NL
Risso's dolphin	WMED	5,320	0.0011	NL
Short-beaked common dolphin	WMED	19,428	0.00144	NL
Common bottlenose dolphin	WMED	1,676	0.00058	NL
Sperm whale	WMED	396	0.00052	EN
Striped dolphin	WMED	117,880	0.0436	NL

[1] ENA = eastern north Atlantic; MED = Mediterranean; WMED = western Mediterranean.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 18—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 16, ARABIAN SEA

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Blue whale	NIND	3,432	0.00004	EN
Bryde's whale	NIND	9,176	0.0004	NL
Common minke whale	IND	257,500	0.00920	NL
Fin whale	IND	1,716	0.00092	EN
Humpback whale	XAR	200	0.00005	EN
Sperm whale	NIND	24,446	0.00877	EN
Dwarf sperm whale	IND	10,541	0.00006	NL
Cuvier's beaked whale	IND	27,272	0.00308	NL
Deraniyagala beaked whale	IND	16,867	0.00278	NL
Blainville's beaked whale	IND	16,867	0.00276	NL
Ginkgo-toothed beaked whale	IND	16,867	0.00278	NL
Longman's beaked whale	IND	16,867	0.01193	NL

TABLE 18—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 16, ARABIAN SEA—Continued

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
False killer whale	IND	144,188	0.00025	NL
Pygmy killer whale	IND	22,029	0.00141	NL
Melon-headed whale	IND	64,600	0.00931	NL
Short-finned pilot whale	IND	268,751	0.03474	NL
Risso's dolphin	IND	452,125	0.08952	NL
Fraser's dolphin	IND	151,554	0.00194	NL
Common bottlenose dolphin	IND	785,585	0.05521	NL
Pantropical spotted dolphin	IND	736,575	0.00922	NL
Striped dolphin	IND	674,578	0.15196	NL
Spinner dolphin	IND	634,108	0.00718	NL
Rough-toothed dolphin	IND	156,690	0.00075	NL
Long-beaked common dolphin	IND	1,819,882	0.00013	NL
Pygmy sperm whale	IND	10,541	0.00002	NL
Killer whale	IND	12,593	0.00737	NL
Indo-Pacific bottlenose dolphin	IND	7,850	0.00055	NL

[1] IND = Indian Ocean; NIND = northern Indian Ocean; XAR = Stock X Arabian Sea.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 19—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 17, ANDAMAN SEA

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Blue whale	NIND	3,432	0.00003	EN
Bryde's whale	NIND	9,176	0.00037	NL
Common minke whale	IND	257,500	0.00968	NL
Fin whale	IND	1,716	[5] NA	EN
Omura's whale	IND	9,176	0.00037	NL
Sperm whale	NIND	24,446	0.00107	EN
Dwarf sperm whale	IND	10,541	0.00006	NL
Pygmy sperm whale	IND	10,541	0.00001	NL
Cuvier's beaked whale	IND	27,272	0.00480	NL
Blainville's beaked whale	IND	16,867	0.00094	NL
Ginkgo-toothed beaked whale	IND	16,867	0.00097	NL
Longman's beaked whale	IND	16,867	0.00459	NL
Killer whale	IND	12,593	0.00730	NL
False killer whale	IND	144,188	0.00024	NL
Fraser's dolphin	IND	151,554	0.0018	NL
Pygmy killer whale	IND	22,029	0.00125	NL
Melon-headed whale	IND	64,600	0.00878	NL
Short-finned pilot whale	IND	268,751	0.03543	NL
Risso's dolphin	IND	452,125	0.09173	NL
Long-beaked common dolphin	IND	1,819,882	0.00010	NL
Common bottlenose dolphin	IND	785,585	0.07261	NL
Indo-Pacific bottlenose dolphin	IND	7,850	0.00073	NL
Pantropical spotted dolphin	IND	736,575	0.00829	NL
Striped dolphin	IND	674,578	0.14123	NL
Spinner dolphin	IND	634,108	0.00701	NL
Rough-toothed dolphin	IND	156,690	0.00077	NL
Deraniyagala beaked whale	IND	16,867	0.00097	NL

[1] IND = Indian Ocean; NIND = northern Indian Ocean.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 20—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 18, PANAMA CANAL

[Winter season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Blue whale	ENP	1,647	0.00008	EN
Bryde's whale	ETP	13,000	0.0003	NL
Common minke whale	ETP	478	0.00031	NL
Fin whale	ENP	832	[5] NA	EN
Humpback whale	Central America DPS	6,000	0.00001	EN
Sperm whale	ETP	22,700	0.0047	EN
Kogia spp.	ETP	11,200	0.014	NL
Cuvier's beaked whale	ETP	20,000	0.00058	NL
Blainville's beaked whale	ETP	25,300	0.00225	NL
Ginkgo-toothed beaked whale	ETP	25,300	0.0016	NL
Longman's beaked whale	ETP	25,300	0.00225	NL
Pygmy beaked whale	ETP	25,300	0.00225	NL
Killer whale	ETP	8,500	0.00015	NL
False killer whale	ETP	39,800	0.0004	NL
Pygmy killer whale	ETP	38,900	0.0014	NL
Melon-headed whale	ETP	45,400	0.00313	NL
Short-finned pilot whale	ETP	160,200	0.01813	NL
Risso's dolphin	ETP	110,457	0.01781	NL
Short-beaked common dolphin	ETP	3,127,203	0.005	NL
Fraser's dolphin	ETP	289,300	0.001	NL
Common bottlenose dolphin	ETP	335,834	0.0375	NL
Pantropical spotted dolphin	NEOP	640,000	0.0375	NL
Striped dolphin	ETP	964,362	0.08125	NL
Spinner dolphin	Eastern	450,000	0.01875	NL
Rough-toothed dolphin	ETP	107,633	0.00488	NL
Mesoplodon spp.	ETP	25,300	0.00225	NL
Deraniyagala beaked whale	ETP	25,300	0.00225	NL

[1] ETP = eastern tropical Pacific; ENP = eastern northern Pacific; NEOP = northeastern offshore Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 21—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 19, NORTHEASTERN AUSTRALIA

[Spring season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Blue whale	WSP	9,250	0.00001	EN
Fin whale	WSP	9,250	0.0002	EN
Bryde's whale	WSP	20,501	0.0006	NL
Common minke whale	WSP	25,049	0.0044	EN
Humpback whale	East Australia DPS	14,500	0.00089	NL
Omura's whale	WSP	1,800	0.00006	NL
Sei whale	WSP	7,000	0.0006	EN
Sperm whale	WSP	102,112	0.00123	EN
Cuvier's beaked whale	WSP	90,725	0.0054	NL
Blainville's beaked whale	WSP	8,032	0.0005	NL
Ginkgo-toothed beaked whale	WSP	22,799	0.0005	NL
Longman's beaked whale	WSP	4,571	0.00025	NL
Kogia spp.	WSP	350,553	0.0031	NL
Killer whale	WSP	12,256	0.00009	NL
False killer whale	WSP	16,668	0.0029	NL
Pygmy killer whale	WSP	30,214	0.0021	NL
Melon-headed whale	WSP	36,770	0.00428	NL
Risso's dolphin	WSP	83,289	0.0106	NL
Short-beaked common dolphin	WSP	3,286,163	0.0562	NL
Fraser's dolphin	WSP	220,789	0.0069	NL
Common bottlenose dolphin	WSP	168,791	0.0146	NL
Pantropical spotted dolphin	WSP	438,064	0.0137	NL
Striped dolphin	WSP	570,038	0.0329	NL
Spinner dolphin	WSP	1,015,059	0.00083	NL
Pilot whales	WSP	53,608	0.0153	NL

TABLE 21—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 19, NORTHEASTERN AUSTRALIA—Continued

[Spring season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Rough-toothed dolphin	WSP	145,729	0.0059	NL

[1] GVEA = group V east Australia; WSP = western south Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 22—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 20, NORTHWESTERN AUSTRALIA

[Winter season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Blue whale	SIND	1,657	[5] NA	EN
Fin whale	SIND	38,185	0.00001	EN
Bryde's whale	SIND	13,854	0.00032	NL
Antarctic minke whale	ANT	90,000	NA	NL
Common minke whale	IND	257,500	NA	NL
Humpback whale	Western Australia DPS	13,640	NA	NL
Omura's whale	IND	13,854	0.00032	NL
Sei whale	IND	13,854	0.00001	EN
Blainville's beaked whale	IND	16,867	0.00083	NL
Common bottlenose dolphin	IND	3,000	0.03630	NL
Cuvier's beaked whale	IND	76,500	0.00399	NL
Dwarf sperm whale	IND	10,541	0.00004	NL
False killer whale	IND	144,188	0.00020	NL
Fraser's dolphin	IND	151,554	0.00145	NL
Killer whale	IND	12,593	0.00585	NL
Longman's beaked whale	IND	16,867	0.00393	NL
Melon-headed whale	IND	64,600	0.00717	NL
Pantropical spotted dolphin	IND	736,575	0.00727	NL
Pygmy killer whale	IND	22,029	0.00100	NL
Risso's dolphin	IND	452,125	0.07152	NL
Rough-toothed dolphin	IND	156,690	0.00059	NL
Short-finned pilot whale	IND	268,751	0.02698	NL
Southern bottlenose whale	IND	599,300	0.00083	NL
Spade-toothed beaked whale	IND	16,867	0.00083	NL
Sperm whale	SIND	24,446	0.00096	EN
Spinner dolphin	IND	634,108	0.00561	NL
Striped dolphin	IND	674,578	0.12018	NL

[1] ANT = Antarctic; SIND = southern Indian Ocean; IND = Indian Ocean.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 23—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 21, NORTHEAST OF JAPAN

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Blue whale	WNP	9,250	[5] NA	EN
Common minke whale	WNP "O"	25,049	0.0022	NL
Fin whale	WNP	9,250	0.0002	EN
Humpback whale	WNP	1,328	0.00050	EN
North Pacific right whale	WNP	922	0.00001	EN
Sei whale	NP	7,000	0.00029	EN
Western North Pacific gray whale	Western DPS	140	0.00001	EN
Baird's beaked whale	WNP	8,000	0.0029	NL
Cuvier's beaked whale	WNP	90,725	0.0054	NL
Dall's porpoise	WNP	173,638	0.0650	NL
Killer whale	WNP	12,256	0.0036	NL
Pacific white-sided dolphin	NP	931,000	0.0048	NL
Short-beaked common dolphin	WNP	3,286,163	0.0863	NL

TABLE 23—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 21, NORTHEAST OF JAPAN—Continued

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Sperm whale	NP	102,112	0.0022	EN
Stejneger's beaked whale	WNP	8,000	0.0005	NL
Northern fur seal	Western Pacific	503,609	0.01378	NL
Ribbon seal	NP	61,100	0.0452	NL
Spotted seal	Bering Sea DPS	460,268	0.2770	NL
Steller sea lion	West-Asian stock and Western DPS.	62,218	0.00001	EN

[1] IND = Indian Ocean; NP = northern Pacific; WNP = western north Pacific; ENP = eastern north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

TABLE 24—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 22, SOUTHERN GULF OF ALASKA

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Blue whale	ENP	1,647	0.00051	EN
Common minke whale	AK	1,233	0.0006	NL
Eastern North Pacific gray whale	ENP	20,990	0.00019	NL
Fin whale	AK/NE Pacific	1,368	0.00049	EN
Humpback whale	Hawaii DPS	10,103	0.00050	NL
	Mexico DPS			T
	WNP DPS			EN
North Pacific right whale	ENP	31	0.00003	EN
Sei whale	ENP	126	0.00007	EN
Baird's beaked whale	AK	847	0.0004	NL
Cuvier's beaked whale	AK	6,590	0.00245	NL
Dall's porpoise	AK	173,638	0.07214	NL
Killer whale	ENP AK resident	2,347	0.005	NL
Killer whale	ENP Gulf of AK, Aleutian Islands, and Bering Sea Transient.	587	0.00021	NL
Pacific white-sided dolphin	NP	26,880	0.0208	NL
Sperm whale	NP	102,112	0.00127	EN
Stejneger's beaked whale	AK	694	0.00084	NL
Northern elephant seal	California Breeding	179,000	0.0038	NL
Northern fur seal	EP	648,534	0.03211	NL
Ribbon seal	AK	184,000	0.00001	NL
Steller sea lion	Eastern DPS	60,131	0.01085	NL
Steller sea lion	Western DPS	49,497	0.01085	EN

[1] IND = Indian Ocean; NP = northern Pacific; ENP = eastern north Pacific; AK = Alaska.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 25—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 23, SOUTHERN NORWEGIAN BASIN

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Blue whale	ENA	979	0.00001	EN
Common minke whale	Northeast Atlantic	78,572	0.03206	NL
Fin whale	North-West Norway	6,409	0.00157	EN
Humpback whale	Cape Verdes-NW Africa DPS	11,572	0.00009	EN
	West Indies DPS			NL
Sei whale	Iceland-Denmark Strait	10,300	0.00001	EN
Atlantic white-sided dolphin	ENA	3,904	0.00001	NL
Cuvier's beaked whale	ENA	6,992	0.011	NL
Harbor porpoise	ENA	375,358	0.074	NL
Killer whale	Northern Norway	731	0.00001	NL

TABLE 25—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 23, SOUTHERN NORWEGIAN BASIN—Continued

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Long-finned pilot whale	ENA	128,093	0.054	NL
Northern bottlenose dolphin	ENA	19,538	0.0026	NL
Sowerby's beaked whale	ENA	6,992	0.011	NL
Sperm whale	ENA	7,785	0.0049	EN
White-beaked dolphin	ENA	16,536	0.011	NL
Hooded seal	West Ice	84,020	0.00811	NL

[1] ENA = eastern north Atlantic.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 26—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 24, WESTERN NORTH ATLANTIC OFF VIRGINIA/MARYLAND

[Summer season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Common minke whale	Canadian East Coast	20,741	0.00013	NL
Fin whale	WNA	1,618	0.00075	EN
Humpback whale	West Indies DPS	12,312	0.00006	NL
North Atlantic right whale	WNA	476	<0.00001	NL
Atlantic spotted dolphin	WNA	44,715	0.09630	NL
Clymene dolphin	WNA	6,086	0.01424	NL
Common bottlenose dolphin	Offshore WNA	77,532	0.04241	NL
	Northern Migratory Coastal	11,548	0.00236	NL
	Southern Migratory Coastal	9,173	0.00236	NL
Cuvier's beaked whale	WNA	6,532	0.00878	NL
False killer whale	WNA	442	0.00008	NL
Killer whale	WNA	67	0.00001	NL
Kogia spp	WNA	3,785	0.00079	NL
Mesoplodon spp	WNA	7,092	0.00954	NL
Pantropical spotted dolphin	WNA	3,333	0.00515	NL
Risso's dolphin	WNA	18,250	0.02202	NL
Rough-toothed dolphin	WNA	271	0.00060	NL
Short-beaked common dolphin	WNA	173,486	0.07284	NL
Short-finned pilot whale	WNA	21,515	0.02215	NL
Sperm whale	WNA	2,288	0.01274	EN
Spinner dolphin	WNA	262	0.00034	NL
Striped dolphin	WNA	54,807	0.13345	NL

[1] WNA = western north Atlantic.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 27—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 25, LABRADOR SEA

[Winter season]

Species	Stock name [1]	Abundance [2]	Density (animals/km²) [3]	ESA status [4]
Blue whale	WNA	440	0.00002	EN
Common minke whale	Canadian East Coast	20,741	0.00013	NL
Fin whale	Canadian East Coast	1,352	0.00005	EN
Humpback whale	West Indies DPS	12,312	0.00019	NL
North Atlantic right whale	WNA	476	<0.00001	EN
Sei whale	Labrador Sea	965	0.00002	EN
Atlantic white-sided dolphin	Labrador Sea	24,422	0.00200	NL
Harbor porpoise	Newfoundland	3,326	0.00160	NL
Killer whale	WNA	67	0.00001	NL
Long-finned pilot whale	Canadian East Coast	6,134	0.00370	NL
Northern bottlenose dolphin	Davis Strait	50	0.00001	NL
Short-beaked common dolphin	WNA	173,486	0.00100	NL
Sowerby's beaked whale	WNA	50	0.00001	NL
Sperm whale	WNA	2,288	0.00127	EN

TABLE 27—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 25, LABRADOR SEA—Continued

[Winter season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
White-beaked dolphin	Canadian East Coast	15,625	0.00077	NL
Arctic ringed seal	Arctic	787,000	0.07300	NL
Harp seal	WNA	7,411,000	0.07043	NL
Hooded seal	WNA	592,100	0.0081	NL

[1] WNA = western north Atlantic.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.

TABLE 28—ABUNDANCE AND DENSITY ESTIMATES FOR THE MARINE MAMMAL SPECIES, SPECIES GROUPS, AND STOCKS ASSOCIATED WITH MISSION AREA 26, SEA OF OKHOTSK

[Spring season]

Species	Stock name [1]	Abundance [2]	Density (animals/km^2) [3]	ESA status [4]
Bowhead whale	Okhotsk Sea	247	0.00001	EN
Common minke whale	WNP "O"	25,049	0.01727	NL
	WNP "J"	893	0.00062	EN
Fin whale	WNP	9,250	0.0002	EN
Humpback whale	WNP DPS	1,328	0.00089	EN
North Pacific right whale	WNP	922	[5] NA	EN
Western North Pacific gray whale	Western DPS	140	NA	EN
Baird's beaked whale	WNP	8,000	0.0015	NL
Beluga whale	Okhotsk Sea	12,226	0.0071	NL
Cuvier's beaked whale	WNP	90,725	0.0054	Nl
Dall's porpoise	WNP dalli-trype	111,402	0.18031	NL
	WNP truei-type	101,173	0.16375	NL
Harbor porpoise	WNP	31,046	0.0190	NL
Killer whale	Okhotsk-Kamchatka-Western Aleutians Transient.	12,256	0.0036	NL
Pacific white-sided dolphin	NP	931,000	0.0048	NL
Sperm whale	NP	102,112	0.0022	EN
Northern fur seal	Western Pacific	503,609	0.08031	NL
Okhotsk ringed seal	Okhotsk	676,000	0.23881	T
Pacific bearded seal	Okhotsk DPS	200,000	0.01174	T
Ribbon seal	Sea of Okhotsk	124,000	0.0904	NL
Spotted seal	Sea of Okhotsk DPS	180,000	0.2770	NL
Steller sea lion	Western DPS	82,516	0.02189	EN

[1] WNP = western north Pacific.
[2] Refer to Table 3–2 of the Navy's application for literature references associated with abundance estimates presented in this table.
[3] Refer to Table 3–2 of the Navy's application for literature references associated with density estimates presented in this table.
[4] ESA Status: EN = Endangered; T = Threatened; NL = Not Listed.
[5] NA in the Density column indicates that although the stock or DPS occurs in that mission area, it is not expected to occur during the season modeled.

Information on how the density and stock/abundance estimates were derived for the selected mission sites is in the Navy's application. These data are derived from the best available, published source documentation, and provide general area information for each mission area with species-specific information on the animals that could occur in that area, including estimates for their stock abundance and density. The Navy developed the abundance and density estimates by first using estimates from line-transect surveys that occurred in or near each of the 26 model sites (*e.g.,* Barlow, 2006). However, density estimates require more sophisticated sampling and analysis and were not always available for each species at all sites. When density estimates were not available from a survey in the operating area, the Navy extrapolated density estimates from a region with similar oceanographic characteristics to that operating area. For example, the eastern tropical Pacific has been extensively surveyed and provides a comprehensive understanding of marine mammals in temperate oceanic waters (Ferguson and Barlow, 2001, 2003). Density estimates for some mission areas/model sites were also derived from the Navy's Marine Species Density Database (DoN, 2016b). In addition, density estimates are usually not available for rare marine mammal species or for those that have been newly defined (*e.g.,* the Deraniyagala's beaked whale). For these species, the lowest density estimate of 0.0001 animals/square kilometer (0.0001 animals/km^2) was used in the take analysis to reflect the low probability of occurrence in a specific SURTASS LFA sonar mission area. Further, the Navy pooled density estimates for species of the same genus if sufficient data are not available to compute a density for individual species or the species are difficult to distinguish at sea, which is often the case for pilot whales and beaked whales, as well as the pygmy and dwarf sperm whales. Density estimates are available for these species groups rather than the individual species.

The Navy provides detailed descriptions of the distribution, abundance, diving behavior, life history, and hearing vocalization information for each affected marine mammal species with confirmed or possible occurrence within SURTASS LFA sonar operational areas in section 4 (pages 4–1 through 4–71) of the application, which is available online at *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*).

Although not repeated in this document, NMFS has reviewed these data, determined them to be the best available scientific information for the proposed rulemaking, and considers this information part of the administrative record for this action. Additional information is available in NMFS' Marine Mammal Stock Assessment Reports, which may be viewed at *http://www.nmfs.noaa.gov/pr/sars/species.htm.* NMFS refers the public to Table 3–2 (pages 3–9 through 3–36) of the Navy's application for literature references associated with abundance and density estimates presented in these tables.

Brief Background on Sound, Marine Mammal Hearing, and Vocalization

Underwater Sound

An understanding of the basic properties of underwater sound is necessary to comprehend many of the concepts and analyses presented in this document. Sound is a wave of pressure variations propagating through a medium (for the sonar considered in this proposed rulemaking, the medium is seawater). Pressure variations are created by compressing and relaxing the medium. Sound measurements can be expressed in two forms: Intensity and pressure. Acoustic intensity is the average rate of energy transmitted through a unit area in a specified direction and is expressed in watts per square meter (W/m^2). Acoustic intensity is rarely measured directly, it is derived from ratios of pressures; the standard reference pressure for underwater sound is 1 μPa (Richardson *et al.,* 1995).

Acousticians have adopted a logarithmic scale for sound intensities, which is denoted in dB. The logarithmic nature of the scale means that each 10 dB increase is a ten-fold increase in power (*e.g.,* 20 dB is a 100-fold increase, 30 dB is a 1,000-fold increase). Humans perceive a 10-dB increase in noise as a doubling of sound level, or a 10-dB decrease in noise as a halving of sound level. Sound pressure level or SPL implies a decibel measure and a reference pressure that is used as the denominator of the ratio.

Sound frequency is measured in cycles per second, referred to as Hertz (Hz), and is analogous to musical pitch; high-pitched sounds contain high frequencies and low-pitched sounds contain low frequencies. Natural sounds in the ocean span a large range of frequencies: From earthquake noise at five Hz to harbor porpoise clicks at 150,000 Hz (150 kilohertz (kHz)). These sounds are so low or so high in pitch that humans cannot even hear them; acousticians call these infrasonic (typically below 20 Hz, which is considered the low frequency bound of human hearing) and ultrasonic (typically above 20,000 Hz, which is considered the upper bound of human hearing) sounds, respectively. A single sound may be made up of multiple frequencies. Sounds made up of only a small range of frequencies are called narrowband, and sounds with a broad range of frequencies are called broadband. Explosives are an example of a broadband sound source and tactical military sonars are an example of a narrowband sound source.

Metrics Used in This Document

This section includes a brief explanation of the sound measurements frequently used in the discussions of acoustic effects in this document.

Sound Pressure Level

Sound pressure level (SPL) is expressed as the ratio of a measured sound pressure and a reference level. The commonly used reference pressure level in underwater acoustics is 1 μPa, and the units for SPLs are decibels (dB) re: 1 μPa. SPL (in dB) = 20 log (pressure/reference pressure). SPL is an instantaneous measurement and can be expressed as the peak, the peak-peak (p-p), or the root mean square (rms). SPL does not directly take the duration of exposure to a sound into account, though it should be noted that the duration over which the root mean square pressure is averaged since it influences the result. Root mean square pressure, which is the square root of the arithmetic average of the squared instantaneous pressure values (Urick, 1983), is typically used in discussions of behavioral effects of sounds on vertebrates in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures. All references to SPL in this document refer to the root mean square unless otherwise noted.

Cumulative Sound Exposure Level

Sound exposure level (SEL; represented as dB re 1 μPa^2-s) represents the total energy contained within a pulse, and considers both exposure level and duration of exposure. The NMFS 2016 Acoustic Technical Guidance builds upon the foundation provided by Southall *et al.* (2007), while incorporating new information available since development of that work (*e.g.,* Finneran, 2015). Southall *et al.* (2007) recommended specific thresholds under the dual metric approach (*i.e.,* peak SPL (SPL_{pk}) and cumulative SEL (SEL_{cum})), and that marine mammals be divided into hearing groups based on measured or estimated hearing ranges. The premise of the dual criteria approach is that, while there is no definitive answer to the question of which acoustic metric is most appropriate for assessing the potential for auditory injury, both the exposure level and duration of received signals are important to an understanding of the potential for injury. Therefore, peak SPL is used to define a pressure criterion above which auditory injury is predicted to occur, regardless of exposure duration (*i.e.,* any single exposure at or above this level is considered to cause auditory injury), and the SEL_{cum} metric is used to account for the total energy received over the specified duration of sound exposure (*i.e.,* metric accounts for both received level and duration of exposure) (Southall *et al.,* 2007; NMFS, 2016). As SPL_{pk} is applicable to impulsive noise, it is not applicable to SURTASS LFA sonar and is not discussed further here. Note that SEL_{cum} acoustic thresholds also incorporate marine mammal auditory weighting functions. NMFS (2016) recommends 24 hours as a maximum accumulation period relative to SEL_{cum} thresholds. For further discussion of auditory weighting functions and their application or metrics associated with evaluating noise-induced hearing loss, please see NMFS (2016). Table 29 displays auditory impact thresholds provided by NMFS (2016).

TABLE 29—TTS AND PTS ONSET THRESHOLDS FOR NON-IMPULSIVE SOUNDS [1]

Hearing group	Cumulative sound exposure level for TTS [1] (dB)	Cumulative sound exposure level for PTS [1] (dB)
Low-frequency cetaceans	179	199
Mid-frequency cetaceans	178	198
High-frequency cetaceans	153	173
Phoicid pinnipeds (PW) (Underwater)	181	201
Otariid pinnipeds (OW) (Underwater)	199	219

[1] Referenced to 1 μPa²s; weighted according to appropriate auditory weighting function.

Single Ping Equivalent (SPE)

To model potential behavioral impacts to marine animals from exposure to SURTASS LFA sonar sound, the Navy has developed a methodology to estimate the total exposure of modeled animals exposed to multiple pings over an extended period of time. The Navy's acoustic model analyzes the following components: (1) The LFA sonar source modeled as a point source, with an effective source level (SL) in dB re: 1 μPa at 1 m (SPL); (2) a 60-sec duration signal; and (3) a beam pattern that is correct for the number and spacing of the individual projectors (source elements). This source model, when combined with the three-dimensional transmission loss (TL) field generated by the Parabolic Equation (PE) acoustic propagation model, defines the received level (RL) (in SPL) sound field surrounding the source for a 60-sec LFA sonar signal (*i.e.,* the SPE metric accounts for received level and exposure from multiple pings). To estimate the total exposure of animals exposed to multiple pings, the Navy models the RLs for each modeled location and any computer-simulated marine mammals (animats) within the location, records the exposure history of each animat, and generates a SPE value. Thus, the Navy can model the SURTASS LFA sound field, providing a four-dimensional (position and time) representation of a sound pressure field within the marine environment and estimates of an animal's exposure to sound over a period of 24 hours.

Figure 2 shows the Navy calculation that converts SPL values to SPE values in order to estimate impacts to marine mammals from SURTASS LFA sonar transmissions. For a more detailed explanation of the SPE calculations, NMFS refers the public to Appendix B of the Navy's 2016 DSEIS/SOEIS.

Figure 2. Equation for SPE as a Function for SPL.

$$SPE = 5 \times \text{Log}_{10} \left(\sum \left(10^{(P_N/10)} \right)^2 \right)$$

SPE is the single ping equivalent of the N received transmissions at the animal.

N is the number of received transmissions at the animal, and

P_N is the received level or pressure in in dB re: 1 μPa (in SPL) at the modeled animal for each received transmission

Marine Mammal Hearing

Cetaceans have an auditory anatomy that follows the basic mammalian pattern, with some changes to adapt to the demands of hearing in the sea. The typical mammalian ear is divided into an outer ear, middle ear, and inner ear. The outer ear is separated from the inner ear by a tympanic membrane, or eardrum. In terrestrial mammals, the outer ear, eardrum, and middle ear transmit airborne sound to the inner ear, where the sound waves are propagated through the cochlear fluid. Since the impedance of water (*i.e.,* the product of density and sound speed) is close to that of the tissues of a cetacean, the outer ear is not required to transduce sound energy as it does when sound waves travel from air to fluid (inner ear). Sound waves traveling through the inner ear cause the basilar membrane to vibrate. Specialized cells, called hair cells, respond to the vibration and produce nerve pulses that are transmitted to the central nervous system. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Pickles, 1998).

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms derived using auditory evoked potential (AEP) techniques, anatomical modeling, and other data, Southall *et al.* (2007) designated "functional hearing groups" for marine mammals and estimated the lower and upper frequencies of functional hearing (*i.e.,* the frequencies that the species can actually hear) of these groups as follows:

- Low frequency (LF) cetaceans (13 species of mysticetes): Southall *et al.* (2007) estimates that functional hearing occurs between approximately seven Hz and 22 kHz;
- Mid-frequency (MF) cetaceans (32 species of dolphins, six species of larger toothed whales, and 19 species of beaked and bottlenose whales): Southall *et al.* (2007) estimates that functional hearing occurs between approximately 150 Hz and 160 kHz;
- High frequency (HF) cetaceans (eight species of true porpoises, six species of river dolphins, *Kogia,* the franciscana, and four species of cephalorhynchids): Southall *et al.* (2007) estimates that functional hearing

occurs between approximately 200 Hz and 180 kHz.

- Pinnipeds in Water: Southall *et al.* (2007) estimates that functional hearing occurs between approximately 75 Hz and 75 kHz, with the greatest sensitivity between approximately 700 Hz and 20 kHz.

In August 2016 NMFS released its Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS 2016 Acoustic Technical Guidance), which modified the hearing groups proposed in Southall *et al.* (2007) in the following ways:

- Division of pinnipeds into phocids in water (PW) and otariids in water (OW) hearing groups; and
- Re-Categorization of two species of dolphins (hourglass [*Lagenorhynchus cruiger*] and Peale's [*L. australis*]) from mid-frequency (MF) to high-frequency (HF) hearing group.

Therefore, under the new NMFS 2016 Acoustic Technical Guidance, there are five marine mammal hearing group categories, with associated generalized hearing ranges as shown in Table 30 (note that animals are less sensitive to sounds at the outer edge of their generalized hearing range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range).

TABLE 30—MARINE MAMMAL HEARING GROUPS

[NMFS, 2016]

Hearing group	Generalized hearing range [1]
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz.
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz.
High-frequency (HF) cetaceans (true porpoises, *Kogia,* river dolphins, cephalorhynchid, *Lagenorhynchus* cruciger & *L. australis*).	275 Hz to 160 kHz.
Phocid pinnipeds underwater (PW) (true seals)	50 Hz to 86 kHz.
Otariid pinnipeds underwater (OW) (sea lions and fur seals)	60 Hz to 39 kHz.

[1] Represents the generalized hearing range for the entire group as a composite (*i.e.,* all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall *et al.* 2007) and PW pinniped (approximation).

Marine Mammal Hearing Groups and LFA Sonar

Baleen (mysticete) whales (members of the LF hearing group) have inner ears that appear to be specialized for low-frequency hearing. Conversely, most odontocetes (*i.e.,* dolphins and porpoises) have inner ears that are specialized to hear mid and high frequencies. Pinnipeds, which lack the highly specialized active biosonar systems of odontocetes, have inner ears that are specialized to hear a broad range of frequencies in water (Southall *et al.,* 2007). Based on an extensive suite of reported laboratory measurements (DoN, 2001, Ketten, 1997, Southall *et al.,* 2007), the LFA sound source is below the range of best hearing sensitivity for MF and HF odontocete and pinnipeds in water hearing specialists (Clark and Southall, 2009).

Marine Mammal Vocalization

Marine mammal vocalizations often extend both above and below the range of human hearing (higher than 20 kHz and lower than 20 Hz; Research Council, 2003). Measured data on the hearing abilities of cetaceans are sparse, particularly for the larger cetaceans such as the baleen whales. The auditory thresholds of some of the smaller odontocetes have been determined in captivity. It is generally believed that cetaceans should at least be sensitive to the frequencies of their own vocalizations. Comparisons of the anatomy of cetacean inner ears and models of the structural properties and the response to vibrations of the ear's components in different species provide an indication of likely sensitivity to various sound frequencies. Thus, the ears of small toothed whales are optimized for receiving high-frequency sound, while baleen whale inner ears are best suited for low frequencies, including to infrasonic frequencies (Ketten, 1992; 1997; 1998).

Baleen whale (*i.e.,* mysticete) vocalizations are composed primarily of frequencies below one kHz, and some contain fundamental frequencies as low as 16 Hz (Watkins *et al.,* 1987; Richardson *et al.,* 1995; Rivers, 1997; Moore *et al.,* 1998; Stafford *et al.,* 1999; Wartzok and Ketten, 1999) but can be as high as 24 kHz (humpback whale; Au *et al.,* 2006). Clark and Ellison (2004) suggested that baleen whales use low frequency sounds not only for long-range communication, but also as a simple form of echo ranging, using echoes to navigate and orient relative to physical features of the ocean. Information on auditory function in mysticetes is limited. Sensitivity to low frequency sound by baleen whales has been inferred from observed vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses of the auditory system. Although there is apparently much variation, the source levels of most baleen whale vocalizations lie in the range of 150–190 dB re: 1 μPa at 1 m. Low-frequency vocalizations made by baleen whales and their corresponding auditory anatomy suggest that they have good low-frequency hearing (Ketten, 2000), although specific data on sensitivity, frequency or intensity discrimination, or localization abilities are lacking. Marine mammals, like all mammals, have typical U-shaped audiograms that begin with relatively low sensitivity (high threshold) at some specified low frequency with increased sensitivity (low threshold) to a species-specific optimum followed by a generally steep rise at higher frequencies (high threshold) (Fay, 1988).

Toothed whales (*i.e.,* odontocetes) produce a wide variety of sounds, which include species-specific broadband ''clicks'' with peak energy between 10 and 200 kHz, individually variable ''burst pulse'' click trains, and constant frequency or frequency-modulated (FM) whistles ranging from 4 to 16 kHz (Wartzok and Ketten, 1999). The general consensus is that the tonal vocalizations (whistles) produced by toothed whales play an important role in maintaining contact between dispersed individuals, while broadband clicks are used during echolocation (Wartzok and Ketten, 1999). Burst pulses have also been strongly implicated in communication, with some scientists suggesting that they play an important role in agonistic encounters (McCowan and Reiss, 1995), while others have proposed that they represent ''emotive'' signals in a broader sense, possibly representing graded communication signals (Herzing, 1996). Sperm whales, however, are known to produce only clicks, which are used for both communication and echolocation (Whitehead, 2003). Most of the energy of toothed whales' social vocalizations is concentrated near 10 kHz, with source levels for whistles as high as 100–180 dB re 1 μPa at 1 m (Richardson *et al.,* 1995). No odontocete has been shown audiometrically to have acute hearing (less than 80 dB re 1 μPa at 1 m) below 500 Hz (DoN, 2001; Ketten, 1998). Sperm whales produce clicks, which may be used to echolocate (Mullins *et al.,* 1988), with a frequency range from less than 100 Hz to 30 kHz and source levels up to 230 dB re 1 μPa at 1 m or greater (Mohl *et al.,* 2000).

Potential Effects of the Specified Activity on Marine Mammals and Their Habitat

This section includes a summary and discussion of the ways that components of the specified activities may impact marine mammals and their habitat. The Estimated Take of Marine Mammals section later in this document will include a quantitative analysis of the maximum percentage of the affected stocks that are expected to be taken by the SURTASS LFA activities, but enumeration of takes of individuals is completed annually when the Navy submits their application for LOAs for that year's mission areas. The Negligible Impact Analysis and Determination section will consider the content of this section, the Estimated Take of Marine Mammals section, and the Proposed Mitigation section to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks.

The Navy has requested authorization for the incidental take of marine mammals that may result from upcoming use of SURTASS LFA sonar by a maximum of four U.S. Naval ships in certain areas of the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea. In addition to the use of LFA and HF/M3 sonar, the Navy has analyzed the potential impact of ship strike to marine mammals from SURTASS LFA sonar activities, and, in consultation with NMFS as a cooperating agency for the SURTASS LFA sonar 2016 DSEIS/SOEIS, has determined that take of marine mammals incidental to this non-acoustic component of the Navy's operations is not reasonably likely to occur. Therefore, the Navy has not requested authorization for take of marine mammals that might occur incidental to vessel ship strike. In this document, NMFS analyzes the potential effects on marine mammals from exposure to LFA and HF/M3 sonar, but also includes some additional analysis of the potential impacts from vessel operations.

NMFS' analysis of potential impacts from SURTASS LFA activities is outlined in the next section. NMFS will focus qualitatively on the different ways that SURTASS LFA sonar activities may affect marine mammals (some of which may not be classifiedas takes). Then, in the Estimated Take of Marine Mammals section, NMFS will relate the potential effects to marine mammals from SURTASS LFA sonar activities to the MMPA definitions of take, including Level A and Level B Harassment.

The potential effects to marine mammals described in the following sections do not take into consideration the proposed mitigation and related monitoring measures described later in this document (see the Proposed Mitigation section) which, as noted, are designed to effect the least practicable adverse impact on affected marine mammals species and stocks.

Potential Effects of Exposure to SURTASS LFA Sonar Activities

The potential effects of sound from the proposed activities associated with SURTASS LFA sonar might include one or more of the following: Behavioral changes, masking, non-auditory injury (*i.e.,* gas bubble formation/rectified diffusion), and noise-induced loss of hearing sensitivity (more commonly called threshold shift). NMFS discusses these potential effects in more detail below.

The effects of underwater noise on marine mammals are highly variable, and one can categorize the effects as follows (Richardson *et al.,* 1995; Nowacek *et al.,* 2007; Southall *et al.,* 2007):

(1) The noise may be too weak to be heard at the location of the animal (*i.e.,* lower than the prevailing ambient noise level, the hearing threshold of the animal at relevant frequencies, or both);

(2) The noise may be audible but not strong enough to elicit any overt behavioral response;

(3) The noise may elicit behavioral reactions of variable conspicuousness and variable relevance to the well-being of the animal. These can range from temporary alert responses to active avoidance reactions such as vacating an area at least until the noise event ceases, but potentially for longer periods of time;

(4) Upon repeated exposure, a marine mammal may exhibit diminishing responsiveness (habituation), disturbance effects may persist, or disturbance effects could increase (sensitization, or becoming more sensitive to exposure). Persistent disturbance and sensitization are more likely with sounds that are highly variable in characteristics, infrequent, and unpredictable in occurrence, and associated with situations that the animal perceives as a threat (animals are not likely to be exposed enough to SURTASS LFA sonar to exhibit habituation or increased sensitization, due to the fact that SURTASS LFA sonar is a mobile source operating in open water, and animals are likely to move away and/or would not be receiving pings in the way that small resident populations would receive with a stationary source);

(5) Any anthropogenic (human-made) noise that is strong enough to be heard has the potential to reduce the ability of a marine mammal to hear natural sounds at similar frequencies (masking), including calls from conspecifics (*i.e.,* an organism of the same species), and underwater environmental sounds such as surf noise;

(6) If mammals remain in an area because it is important for feeding, breeding, or some other biologically important purpose even though there is a chronic exposure to noise, it is possible that there could be noise-induced physiological stress. This might in turn have negative effects on the well-being or reproduction of the animals involved; and

(7) Very strong sounds have the potential to cause temporary or permanent reduction in hearing sensitivity, also known as threshold shift. In terrestrial mammals and presumably marine mammals, received sound levels must far exceed the animal's hearing threshold for there to be any temporary threshold shift (TTS) in its hearing ability. For transient sounds, the sound level necessary to cause TTS is inversely related to the duration of the sound. Received sound levels must be even higher for there to be the possibility of permanent hearing impairment. In addition, intense acoustic or explosive events (not relevant for this proposed activity) may cause trauma to tissues associated with organs vital for hearing, sound production, respiration and other functions. This trauma may include minor to severe hemorrhage.

Direct Physiological Effects

Threshold Shift (Noise-Induced Loss of Hearing)

When animals exhibit reduced hearing sensitivity within their auditory range (*i.e.,* sounds must be louder for an animal to detect them) following exposure to a sufficiently intense sound or a less intense sound for a sufficient duration, it is referred to as a noise-induced threshold shift (TS). An animal can experience a temporary threshold shift (TTS) and/or permanent threshold shift (PTS). TTS can last from minutes or hours to days (*i.e.,* there is recovery back to baseline/pre-exposure levels), can occur within a specific frequency range (*i.e.,* an animal might only have a temporary loss of hearing sensitivity within a limited frequency band of its auditory range), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced by only six dB or reduced by 30 dB). PTS is permanent (*i.e.,* there is incomplete recovery back to baseline/pre-exposure levels), but also can occur in a specific frequency range and amount as mentioned above for TTS.

The following physiological mechanisms are thought to play a role in inducing auditory TS: Effects to sensory hair cells in the inner ear that reduce their sensitivity; modification of the chemical environment within the sensory cells; residual muscular activity in the middle ear; displacement of certain inner ear membranes; increased blood flow; and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.,* 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all can affect the amount of associated TS and the frequency range in which it occurs. Generally, the amount of TS, and the time needed to recover from the effect, increase as amplitude and duration of sound exposure increases. Human non-impulsive noise exposure guidelines are based on the assumption that exposures of equal energy (the same SEL) produce equal amounts of hearing impairment regardless of how the sound energy is distributed in time (NIOSH, 1998). Previous marine mammal TTS studies have also generally supported this equal energy relationship (Southall *et al.,* 2007). However, some more recent studies concluded that for all noise exposure situations the equal energy relationship may not be the best indicator to predict TTS onset levels (Mooney *et al.,* 2009a and 2009b; Kastak *et al.,* 2007). These studies highlight the inherent complexity of predicting TTS onset in marine mammals, as well as the importance of considering exposure duration when assessing potential impacts. Generally, with sound exposures of equal energy, those that were quieter (lower sound pressure level (SPL)) with longer duration were found to induce TTS onset at lower levels than those of louder (higher SPL) and shorter duration. Less TS will occur from intermittent sounds than from a continuous exposure with the same energy (some recovery can occur between intermittent exposures) (Kryter *et al.,* 1966; Ward, 1997; Mooney *et al.* 2009a, 2009b; Finneran *et al.* 2010). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer (lower SPL) sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward, 1997). Additionally, though TTS is temporary, very prolonged or repeated exposure to sound strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold can cause PTS, at least in terrestrial mammals (Kryter, 1985; Lonsbury-Martin *et al.* 1987). However, in the case of the proposed SURTASS LFA sonar activities, animals are not expected to be exposed to levels high enough or durations long enough to result in PTS due to the nature of the activities. The potential for PTS becomes even more unlikely when mitigation measures are considered.

PTS is considered auditory injury (Southall *et al.,* 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.,* 2007).

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. The NMFS 2016 Acoustic Technical Guidance, which was used in the assessment of effects for this action, compiled, interpreted, and synthesized the best available scientific information for noise-induced hearing effects for marine mammals to derive updated thresholds for assessing the impacts of noise on marine mammal hearing, as noted above. For cetaceans, published data on the onset of TTS are limited to the captive bottlenose dolphin, beluga, harbor porpoise, and Yangtze finless porpoise (summarized in Finneran, 2015). TTS studies involving exposure to SURTASS LFA or other low-frequency sonar (below 1 kHz) have never been conducted due to logistical difficulties of conducting experiments with low frequency sound sources. However, there are TTS measurements for exposures to other LF sources, such as seismic airguns. Finneran *et al.* (2015) suggest that the potential for airguns to cause hearing loss in dolphins is lower than previously predicted, perhaps as a result of the low-frequency content of airgun impulses compared to the high-frequency hearing ability of dolphins. For pinnipeds in water, measurements of TTS are limited to harbor seals, elephant seals, and California sea lions (summarized in Finneran, 2015).

Marine mammal hearing plays a critical role in communication with conspecifics and in interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.,* recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious similar to those discussed in auditory masking, below. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that takes place during a time when the animal is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during a time when communication is critical for successful mother/calf interactions could have more serious impacts if it were in the same frequency band as the necessary vocalizations and of a severity that impeded communication. The fact that animals exposed to high levels of sound that would be expected to result in this physiological response would also be expected to have behavioral responses of a comparatively more severe or sustained nature is potentially more significant than simple existence of a TTS. However, it is important to note that TTS could occur due to longer exposures to sound at lower levels so that a behavioral response may not be elicited.

Depending on the degree and frequency range, the effects of PTS on an animal could also range in severity, although it is considered generally more serious than TTS because it is a permanent condition. Of note, reduced hearing sensitivity as a simple function of aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.,* 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without some cost to the animal. There is no empirical evidence that exposure to SURTASS LFA sonar can cause PTS in any marine mammals, especially given the proximity to and duration that an animal would need to be exposed; instead the possibility of PTS has been inferred from studies of TTS on captive marine mammals (see Richardson *et al.,* 1995).

As stated in the Navy's DSEIS/SOEIS (section 4.2.3), results show that all hearing groups except LF cetaceans would need to be within 22 ft (7 m) for an entire LFA transmission (60 seconds) to potentially experience PTS. A LF cetacean would need to be within 135 ft (41 m) for an entire LFA transmission to potentially experience PTS. Based on the mitigation procedures used during SURTASS LFA sonar activities, and the fact that animals can be expected to move away from any disturbance, the chances of this occurring are negligible.

Acoustically Mediated Bubble Growth

One theoretical cause of injury to marine mammals is rectified diffusion (Crum and Mao, 1996), the process of increasing the size of a bubble by exposing it to a sound field. This process could be facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard, 1979). The deeper and longer dives of some marine mammals (*e.g.,* beaked whales) are theoretically predicted to induce greater supersaturation (Houser *et al.,* 2001b). A study of repetitive diving in trained bottlenose dolphins found no increase in blood nitrogen levels or formation of bubbles (Houser *et al.,* 2009). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness.

It is unlikely that the short duration of the SURTASS LFA sonar pings would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. However, an alternative but related hypothesis has also been suggested; stable bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become a problematic size. Research with *ex vivo* supersaturated bovine tissues suggests that, for a 37 kHz signal, a sound exposure of approximately 215 dB re 1μPa would be required before microbubbles became destabilized and grew (Crum *et al.,* 2005). Furthermore, tissues in the study were supersaturated by exposing them to pressures of 400–700 kiloPascals for periods of hours and then releasing them to ambient pressures. Assuming the equilibration of gases with the tissues occurred when the tissues were exposed to high pressures, levels of supersaturation in the tissues could have been as high as 400–700 percent. These levels of tissue supersaturation are substantially higher than model predictions for marine mammals (Houser *et al.,* 2001; Saunders *et al.,* 2008). Both the degree of supersaturation and exposure levels observed to cause microbubble destabilization are unlikely to occur, either alone or in concert.

Yet another hypothesis (decompression sickness) speculates that rapid ascent to the surface following exposure to a startling sound might produce tissue gas saturation sufficient for the evolution of nitrogen bubbles (Jepson *et al.,* 2003; Fernandez *et al.,* 2005; Fernandez *et al.,* 2012). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Alternatively, Tyack *et al.* (2006) studied the deep diving behavior of beaked whales and concluded that: ''Using current models of breath-hold diving, we infer that their natural diving behavior is inconsistent with known problems of acute nitrogen supersaturation and embolism.'' Collectively, these hypotheses (rectified diffusion and decompression sickness) can be referred to as ''hypotheses of acoustically-mediated bubble growth.''

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann, 2004; Evans and Miller, 2003; Cox *et al.,* 2006; Rommel *et al.,* 2006). Crum and Mao (1996) hypothesized that received levels would have to exceed 190 dB in order for there to be the possibility of significant bubble growth due to supersaturation of gases in the blood (*i.e.,* rectified diffusion). Work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at exposure levels and tissue saturation levels that are highly improbable to occur in diving marine mammals. To date, energy levels predicted to cause in vivo bubble formations within diving cetaceans have not been evaluated (NOAA, 2002b). Although it has been argued that traumas from some beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.,* 2003), there is no conclusive evidence of this (Rommel *et al.,* 2006). However, Jepson *et al.* (2003, 2005) and Fernandez *et al.* (2004, 2005, 2012) concluded that in vivo bubble formation, which may be exacerbated by deep, long-duration, repetitive dives, may explain why beaked whales appear to be particularly vulnerable to MF/HF active sonar exposures. This has not been demonstrated for LF sonar exposures, such as SURTASS LFA sonar.

In 2009, Hooker *et al.* tested two mathematical models to predict blood and tissue tension N2 (P_{N2}) using field data from three beaked whale species: Northern bottlenose whales, Cuvier's beaked whales, and Blainville's beaked whales. The researchers aimed to determine if physiology (body mass, diving lung volume, and dive response) or dive behavior (dive depth and duration, changes in ascent rate, and diel behavior) would lead to differences in P_{N2} levels and thereby decompression sickness risk between species.

In their study, they compared results for previously published time depth recorder data (Hooker and Baird, 1999; Baird *et al.,* 2006, 2008) from Cuvier's beaked whale, Blainville's beaked whale, and northern bottlenose whale. They reported that diving lung volume and extent of the dive response had a large effect on end-dive P_{N2}. Also, results showed that dive profiles had a larger influence on end-dive P_{N2} than body mass differences between species. Despite diel changes (*i.e.,* variation that occurs regularly every day or most days) in dive behavior, P_{N2} levels showed no consistent trend. Model output suggested that all three species live with tissue P_{N2} levels that would cause a significant proportion of decompression sickness cases in terrestrial mammals. The authors concluded that the dive behavior of Cuvier's beaked whale was different from both Blainville's beaked whale, and northern bottlenose whale, and resulted in higher predicted tissue and blood N2 levels (Hooker *et al.,* 2009) and suggested that the prevalence of Cuvier's beaked whales stranding after naval sonar exercises could be explained by either a higher abundance of this species in the affected areas or by possible species differences in behavior and/or physiology related to MF active sonar (Hooker *et al.,* 2009).

Bernaldo de Quiros *et al.* (2012) showed that, among stranded whales, deep diving species of whales had higher abundances of gas bubbles compared to shallow diving species. Kvadsheim *et al.* (2012) estimated blood and tissue P_{N2} levels in species representing shallow, intermediate, deep diving cetaceans following behavioral responses to sonar and their comparisons found that deep diving species had higher end-dive blood and tissue N_2 levels, indicating a higher risk of developing gas bubble emboli compared with shallow diving species. Fahlmann *et al.* (2014) evaluated dive data recorded from sperm, killer, long-finned pilot, Blainville's beaked and Cuvier's beaked whales before and during exposure to low (1–2 kHz) and mid (2–7 kHz) frequency active sonar (note that SURTASS LFA sonar is transmitted between 100–500 Hz, which is well below the low frequency sonar in these studies) in an attempt to determine if either differences in dive behavior or physiological responses to sonar are plausible risk factors for bubble formation. The authors suggested that CO_2 may initiate bubble formation and growth, while elevated levels of N_2 may be important for continued bubble growth. The authors also suggest that if CO_2 plays an important role in bubble formation, a cetacean escaping a sound source may experience increased metabolic rate, CO_2 production, and alteration in cardiac output, which could increase risk of gas bubble emboli. However, as discussed in Kvadsheim *et al.* (2012), the actual observed behavioral responses to sonar from the species in their study (sperm, killer, long-finned pilot, Blainville's beaked, and Cuvier's beaked whales) did not imply any significantly increased risk of decompression sickness due to high levels of N_2. Therefore, further information is needed to understand the relationship between exposure to stimuli, behavioral response (discussed in more detail below), elevated N_2 levels, and gas bubble emboli in marine mammals. The hypotheses for gas bubble formation related to beaked whale strandings is that beaked whales potentially have strong avoidance responses to MF active sonars because they sound similar to their main predator, the killer whale (Cox *et al.,* 2006; Southall *et al.,* 2007; Zimmer and Tyack, 2007; Baird *et al.,* 2008; Hooker *et al.,* 2009). Further investigation is needed to assess the potential validity of these hypotheses. However, because SURTASS LFA sonar transmissions are lower in frequency (less than 500 Hz) and dissimilar in characteristics from those of marine mammal predators the SURTASS LFA sonar transmissions are not expected to cause gas bubble formation or beaked whale strandings.

To summarize, there are few data related to the potential for strong, anthropogenic underwater sounds to cause non-auditory physical effects in marine mammals. Such effects, if they occur at all, would presumably be limited situations where marine mammals were exposed to high powered sounds at close range over a prolonged period of time. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.,* 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways.

Acoustic Masking

Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, and learning about their environment (Erbe and Farmer, 2000; Tyack, 2000). Masking, or auditory interference, generally occurs when other sounds in the environment are of a similar frequency and are louder than auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disrupt the behavior of individual animals, groups of animals, or entire populations.

The extent of the masking interference depends on the spectral, temporal, and spatial relationships between the signals an animal is trying to receive and the masking noise, in addition to other factors. In humans, significant masking of tonal signals occurs as a result of exposure to noise in a narrow band of similar frequencies. As the sound level increases, the detection of frequencies above those of the masking stimulus decreases. This principle is expected to apply to marine mammals as well because of common biomechanical cochlear properties across taxa.

Richardson *et al.* (1995b) argued that the maximum radius of influence of an industrial noise (including broadband low-frequency sound transmission) on a marine mammal is the distance from the source to the point at which the noise can barely be heard. This range is determined by either the hearing sensitivity of the animal or the background noise level present. Industrial masking is most likely to affect some species' ability to detect communication calls and natural sounds (*i.e.,* surf noise, prey noise, etc.) (Richardson *et al.,* 1995).

The echolocation calls of toothed whales are subject to masking by high-frequency sound. Human data indicate that low-frequency sounds can mask high-frequency sounds (*i.e.,* upward masking). Studies on captive odontocetes by Au *et al.* (1974, 1985, 1993) indicate that some species may use various processes to reduce masking effects (*e.g.,* adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the higher frequencies these cetaceans use to echolocate, but not at the low-to-moderate frequencies they use to communicate (Zaitseva *et al.,* 1980). A study by Nachtigall and Supin (2008) showed that false killer whales adjust their hearing to compensate for ambient sounds and the intensity of returning echolocation signals. Holt *et al.* (2009) measured killer whale call source levels and background noise levels in the one to 40 kHz band and reported that the whales increased their call source levels by one dB SPL for every one dB SPL increase in background noise level. Similarly, another study on St. Lawrence River belugas reported a similar rate of increase in vocalization activity in response to passing vessels (Scheifele *et al.,* 2005).

Parks *et al.* (2007) provided evidence of behavioral changes in the acoustic behaviors of the endangered North Atlantic right whale, and the South Atlantic right whale, and suggested that these were correlated to increased underwater noise levels. The study indicated that right whales might shift the frequency band of their calls to compensate for increased in-band background noise. The significance of their result is the indication of potential species-wide behavioral change in response to gradual, chronic increases in underwater ambient noise. Di Iorio and Clark (2010) showed that blue whale calling rates vary in association with seismic sparker survey activity, with whales calling more on days with survey than on days without surveys. They suggested that the whales called more during seismic survey periods as a way to compensate for the elevated noise conditions.

Risch *et al.* (2012) documented reductions in humpback whale vocalizations in the Stellwagen Bank National Marine Sanctuary concurrent with transmissions of the Ocean Acoustic Waveguide Remote Sensing (OAWRS) low-frequency fish sensor system at distances of 200 km (124 mi) from the source. The recorded OAWRS produced a series of frequency modulated pulses and the signal received levels ranged from 88 to 110 dB re: 1 μPa (Risch, *et al.,* 2012). The authors hypothesized that individuals did not leave the area but instead ceased singing and noted that the duration and frequency range of the OAWRS signals (a novel sound to the whales) were similar to those of natural humpback whale song components used during mating (Risch *et al.,* 2012). Thus, the novelty of the sound to humpback whales in the study area provided a compelling contextual probability for the observed effects (Risch *et al.,* 2012). However, the authors did not state or imply that these changes had long-term effects on individual animals or populations (Risch *et al.,* 2012).

Redundancy and context can also facilitate detection of weak signals. These phenomena may help marine mammals detect weak sounds in the presence of natural or manmade noise. Most masking studies in marine mammals present the test signal and the masking noise from the same direction. The sound localization abilities of marine mammals suggest that, if signal and noise come from different directions, masking would not be as severe as some masking studies might suggest (Richardson *et al.,* 1995). The dominant background noise may be highly directional if it comes from a particular anthropogenic source such as a ship or industrial site. Directional hearing may significantly reduce the masking effects of these sounds by improving the effective signal-to-noise ratio.

As mentioned previously, the hearing ranges of mysticetes overlap with the frequencies of the SURTASS LFA sonar sources. The closer the characteristics of the masking signal to the signal of interest, the more likely masking is to occur. The Navy provided an analysis of marine mammal hearing and masking in Subchapter 4.2.2.1.4 of the DSEIS/SOEIS, and the masking effects of the SURTASS LFA sonar signal are expected to be limited for a number of reasons. First, the frequency range (bandwidth) of the system is limited to approximately 30 Hz, and the instantaneous bandwidth at any given time of the signal is small, on the order of 10 Hz. Second, the average duty cycle is always less than 20 percent and, based on past SURTASS LFA sonar operational parameters (2003 to 2016), is normally 7.5 to 10 percent. Third, given the average maximum pulse length (60 sec), and the fact that the signals vary and do not remain at a single frequency for more than 10 sec, SURTASS LFA sonar is not likely to cause significant masking. In other words, the LFA sonar transmissions are coherent, narrow bandwidth signals of six to 100 sec in length followed by a quiet period of six to 15 minutes. Therefore, the effect of masking will be limited because animals that use this frequency range typically use broader bandwidth signals. As a result, the chances of an LFA sonar sound actually overlapping whale calls at levels that would interfere with their detection and recognition will be extremely low.

Impaired Communication

In addition to making it more difficult for animals to perceive acoustic cues in their environment, anthropogenic sound presents separate challenges for animals that are vocalizing. When they vocalize, animals are aware of environmental conditions that affect the ''active space'' of their vocalizations, which is the maximum area within which their vocalizations can be detected before they drop to the level of ambient noise (Brenowitz, 2004; Brumm *et al.,* 2004; Lohr *et al.,* 2003). Animals are also aware of environmental conditions that affect whether listeners can discriminate and recognize their vocalizations apart from other sounds, which is more important than simply detecting that a vocalization is occurring (Brenowitz, 1982; Brumm *et al.,* 2004; Dooling, 2004, Marten and Marler, 1977; Patricelli *et al.,* 2006). Most species that vocalize are able to adapt by adjusting their vocalizations to increase the signal-to-noise ratio, active space, and recognizability/distinguishability of their vocalizations in the face of temporary changes in background noise (Brumm *et al.,* 2004; Patricelli *et al.,* 2006). Vocalizing animals can make adjustments to vocalization characteristics such as the frequency structure, amplitude, temporal structure and temporal delivery.

Many animals will combine several of these strategies to compensate for high levels of background noise. Anthropogenic sounds which reduce the signal-to-noise ratio of animal vocalizations, increase the masked auditory thresholds of animals listening for such vocalizations, or reduce the active space of an animal's vocalizations impair communications between animals. Most animals that vocalize have evolved strategies to compensate for the effects of short-term or temporary increases in background or ambient noise on their songs or calls. Although the fitness consequences of these vocal adjustments are not directly known in all instances, like most other trade-offs animals must make, some of these strategies probably come at a cost (Patricelli *et al.,* 2006). Shifting songs and calls to higher frequencies may also impose energetic costs (Lambrechts, 1996). For example in birds, vocalizing more loudly in noisy environments may have energetic costs that decrease the net benefits of vocal adjustment and alter a bird's energy budget (Brumm, 2004; Wood and Yezerinac, 2006).

Stress Responses

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sometimes sufficient to trigger a stress response (Moberg, 2000; Sapolsky *et al.,* 2005; Seyle, 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: Behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses.

According to Moberg (2000), in the case of many stressors, an animal's first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical ''fight or flight'' response which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with ''stress.'' These responses have a relatively short duration and may or may not have significant long-term effect on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine or sympathetic nervous systems; the system that has received the most study has been the hypothalmus-pituitary-adrenal system (also known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuro-endocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg, 1987; Rivier and Rivest, 1991), altered metabolism (Elasser *et al.,* 2000), reduced immune competence (Blecha, 2000), and behavioral disturbance (Moberg, 1987; Blecha, 2000). Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al.,* 2004) have been equated with stress for many years.

The primary distinction between stress, which is adaptive and does not normally place an animal at risk, and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic functions, which impair those functions. For example, when a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When a stress response diverts energy from a fetus, an animal's reproductive success and fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called distress (sensu Seyle, 1950) or allostatic loading (sensu McEwen and Wingfield, 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function. Note that these examples involve a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiments; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005; Thompson and Hamer, 2000).

There is limited information on the physiological responses of marine mammals to anthropogenic sound exposure, as most observations have been limited to short-term behavioral responses, which included cessation of feeding, resting, or social interactions. Information has been collected on the physiological responses of marine mammals to anthropogenic sounds (Fair and Becker, 2000; Romano *et al.,* 2002; Wright *et al.,* 2008), and various efforts have been undertaken to investigate the impact from vessels including whale watching vessels as well as general vessel traffic noise (Bain, 2002; Erbe, 2002; Noren *et al.,* 2009; Williams *et al.,* 2006, 2009, 2014a, 2014b; Read *et al.,* 2014; Rolland *et al.,* 2012; Pirotta *et al.,* 2015). This body of research for the most part has investigated impacts associated with the presence of chronic stressors, which differ significantly from the proposed Navy SURTASS LFA sonar activities. For example, in the analysis of energy costs to killer whales, Williams *et al.* (2009) suggested that whale-watching in Canada's Johnstone Strait resulted in lost feeding opportunities due to vessel disturbance, which could carry higher costs than other measures of behavioral change might suggest. Ayres *et al.* (2012) reported on research in the Salish Sea (state of Washington) involving the measurement of southern resident killer whale fecal hormones to assess two potential threats to the species recovery: Lack of prey (salmon) and impacts to behavior from vessel traffic. The authors suggested that the lack of prey overshadowed any population-level physiological impacts on southern resident killer whales from vessel traffic. Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. In a conceptual model developed by the Population Consequences of Acoustic Disturbance (PCAD) working group, serum hormones were identified as possible indicators of behavioral effects that are translated into altered rates of reproduction and mortality (NRC, 2005). The Office of Naval Research hosted a workshop (Effects of Stress on Marine Mammals Exposed to Sound) in 2009 that focused on this very topic (ONR, 2009). Ultimately, the PCAD working group issued a report (Cochrem, 2014) that summarized information compiled from 239 papers or book chapters relating to stress in marine mammals and concluded that stress responses can last from minutes to hours and, while we typically focus on adverse stress responses, stress response is part of a natural process to help animals adjust to changes in their environment and can also be either neutral or beneficial.

Despite the lack of robust information on stress responses for marine mammals exposed to anthropogenic sounds, studies of other marine and terrestrial animals lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological responses that would be classified as distress upon exposure to low-frequency sounds. For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (*e.g.,* elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al.* (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al.* (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al.* (2004a, 2004b) identified noise-induced physiological transient stress responses in hearing-specialist fish (*i.e.,* goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) and stress in marine mammals remains limited, it is reasonable to assume that reducing an animal's ability to gather information about its environment and communicate with conspecifics could induce stress in animals that use hearing as their primary sensory mechanism. We also assume that acoustic exposures sufficient to trigger onset of PTS or TTS would be accompanied by physiological stress responses, because terrestrial animals exhibit those responses under similar conditions (NRC, 2003). More importantly, due to the effect of noise and the need to effectively gather acoustic information and respond, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset of TTS. Based on empirical studies of the time required to recover from stress responses (Moberg, 2000), NMFS also assumes that stress responses could persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses associated with TTS.

Behavioral Response/Disturbance

Behavioral responses to sound are highly variable and context-specific. Many different variables can influence an animal's perception of, as well as the nature and magnitude of response to, an acoustic event. An animal's prior experience with a sound or sound source affects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future. Animals can also be innately pre-disposed to respond to certain sounds in certain ways (Southall *et al.,* 2007). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), similarity of the sound to biologically relevant sounds in the animal's environment (*i.e.,* calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.,* 2007; DeRuiter *et al.,* 2013). Individuals of different age, gender, reproductive status, etc. among most populations will have variable hearing capabilities, and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (*i.e.,* proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone. For example, Goldbogen *et al.* (2013) demonstrated that individual behavioral state was critically important in determining response of blue whales to sonar, noting that individuals engaged in deep (>50 m) feeding behavior had greater dive responses than those in shallow feeding or non-feeding conditions. Some blue whales in the Goldbogen *et al.* (2013) study that were engaged in shallow feeding behavior demonstrated no clear changes in diving or movement even when RLs were high (~160 dB re 1µPa) for exposures to 3–4 kHz sonar signals, while others showed a clear response at exposures at lower RLs of sonar and pseudorandom noise.

Studies by DeRuiter *et al.* (2012) indicate that variability of responses to acoustic stimuli depends not only on the species receiving the sound and the sound source, but also on the social, behavioral, or environmental contexts of exposure. Another study by DeRuiter *et al.* (2013) examined behavioral responses of Cuvier's beaked whales to MF sonar and found that whales responded strongly at low received levels (RL of 89–127 dB re 1µPa) by ceasing normal fluking and echolocation, swimming rapidly away, and extending both dive duration and subsequent non-foraging intervals when the sound source was 3.4–9.5 km away. Importantly, this study also showed that whales exposed to a similar range of RLs (78–106 dB re 1µPa) from distant sonar exercises (118 km away) did not elicit such responses, suggesting that context may moderate reactions.

Ellison *et al.* (2012) outlined an approach to assessing the effects of sound on marine mammals that incorporates contextual-based factors. The authors recommend considering not just the received level of sound, but also the activity the animal is engaged in at the time the sound is received, the nature and novelty of the sound (*i.e.,* is this a new sound from the animal's perspective), and the distance between the sound source and the animal. They submit that this ''exposure context,'' as it is termed, greatly influences the type of behavioral response exhibited by the animal. This sort of contextual information is challenging to predict with accuracy for ongoing activities that occur over large spatial and temporal expanses. While contextual elements of this sort are typically not included in calculations to quantify take estimates of marine mammals, they are often considered qualitatively in the analysis of the likely consequences of sound exposure, where supporting information is available.

Friedlaender *et al.* (2016) provided the first integration of direct measures of prey distribution and density variables incorporated into across-individual analyses of behavior responses of blue whales to sonar, and demonstrated a 5-fold increase in the ability to quantify variability in blue whale diving behavior. These results illustrate that responses evaluated without such measurements for foraging animals may be misleading, which again illustrates the context-dependent nature of the probability of response.

Exposure of marine mammals to sound sources can result in, but is not limited to, no response or any of the following observable responses: Increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; avoidance; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.,* 2007). A review of marine mammal responses to anthropogenic sound was first conducted by Richardson (1995). More recent reviews (Nowacek *et al.,* 2007; DeRuiter *et al.,* 2012 and 2013; Ellison *et al.,* 2012) addressed studies conducted since 1995 and focused on observations where the received sound level of the exposed marine mammal(s) was known or could be estimated. In a review of experimental field studies to measure behavioral responses of cetaceans to sonar, Southall *et al.* (2016) states that results demonstrate that some individuals of different species display clear yet varied responses, some of which have negative implications, while others appear to tolerate high levels, and that responses may not be fully predicable with simple acoustic exposure metrics (*e.g.,* received sound level). Rather, the authors state that differences among species and individuals along with contextual aspects of exposure (*e.g.,* behavioral state) appear to affect response probability. The following subsections provide examples of behavioral responses that provide an idea of the variability in behavioral responses that would be expected given the different sensitivities of marine mammal species to sound and the wide range of potential acoustic sources to which a marine mammal may be exposed. Predictions about the types of behavioral responses that could occur for a given sound exposure should be determined from the literature that is available for each species or extrapolated from closely related species when no information exists, along with contextual factors.

Alteration of Diving or Movement. Changes in dive behavior can vary widely. They may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive. Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.,* foraging) or they may be of little biological significance. Variations in dive behavior may also expose an animal to potentially harmful conditions (*e.g.,* increasing the chance of ship-strike) or may serve as an avoidance response that enhances survivorship. The impact of a variation in diving resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Nowacek *et al.* (2004) reported disruptions of dive behaviors in foraging North Atlantic right whales when exposed to an alerting stimulus, which they noted could lead to an increased likelihood of ship strike. However, the whales did not respond to playbacks of either right whale social sounds or vessel noise, highlighting the importance of the sound characteristics in producing a behavioral reaction. Conversely, Indo-Pacific humpback dolphins have been observed to dive for longer periods of time in areas where vessels were present and/or approaching (Ng and Leung, 2003). In both of these studies, the influence of the sound exposure cannot be decoupled from the physical presence of a surface vessel, thus complicating interpretations of the relative contribution of each stimulus to the response. Indeed, the presence of surface vessels, their approach, and the speed of approach, all seemed to be significant factors in the response of the Indo-Pacific humpback dolphins (Ng and Leung, 2003). Low-frequency signals of the Acoustic Thermometry of Ocean Climate (ATOC) sound source were not found to affect dive times of humpback whales in Hawaiian waters (Frankel and Clark, 2000) or to overtly affect elephant seal dives (Costa *et al.,* 2003). They did, however, produce subtle effects that varied in direction and degree among the individual seals, illustrating the varied nature of behavioral effects and consequent difficulty in defining and predicting them. Lastly, as noted previously, DeRuiter *et al.* (2013) noted that distance from a sound source may moderate marine mammal reactions in their study of Cuvier's beaked whales showing the whales swimming rapidly and silently away when a sonar signal was 3.4–9.5 km away while showing no such reaction to the same signal when the signal was 118 km away even though the RLs were similar.

Foraging. Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.,* bubble nets or sediment plumes), or changes in dive behavior. Noise from seismic surveys was not found to impact the feeding behavior of western gray whales off the coast of Russia (Yazvenko *et al.,* 2007) and sperm whales engaged in foraging dives did not abandon dives when exposed to distant signatures of seismic airguns (Madsen *et al.,* 2006). Balaenopterid whales exposed to moderate SURTASS LFA sonar demonstrated no responses or change in foraging behavior that could be attributed to the low-frequency sounds (Croll *et al.,* 2001), whereas five out of six North Atlantic right whales exposed to an acoustic alarm interrupted their foraging dives (Nowacek *et al.,* 2004). Although the received sound pressure level was similar in the latter two studies, the frequency, duration, and temporal pattern of signal presentation were different. These factors, as well as differences in species sensitivity, are likely contributing factors to the differential response.

Blue whales exposed to simulated mid-frequency sonar in the Southern California Bight were less likely to produce low frequency calls usually associated with feeding behavior (Melcón *et al.,* 2012). However, the authors were unable to determine if suppression of low frequency calls reflected a change in their feeding performance, or abandonment of foraging behavior and indicated that implications of the documented responses are unknown. Further, it is not known whether the lower rates of calling actually indicated a reduction in feeding behavior or social contact since the study used data from remotely deployed, passive acoustic monitoring buoys. In contrast, blue whales increased their likelihood of calling when ship noise was present, and decreased their likelihood of calling in the presence of explosive noise, although this result was not statistically significant (Melcón *et al.,* 2012). Additionally, the likelihood of an animal calling decreased with the increased received level of mid-frequency sonar, beginning at a SPL of approximately 110–120 dB re 1 μPa (Melcón *et al.,* 2012). Results from the 2010–2011 field season of an ongoing behavioral response study in Southern California waters indicated that, in some cases and at low received levels, tagged blue whales responded to mid-frequency sonar but that those responses were mild and there was a quick return to their baseline activity (Southall *et al.,* 2011; Southall *et al.,* 2012). Goldbogen *et al.,* (2013) monitored behavioral responses of tagged blue whales located in feeding areas when exposed to simulated MFA sonar. Responses varied depending on behavioral context, with deep feeding whales being more significantly affected (*i.e.,* generalized avoidance; cessation of feeding; increased swimming speeds; or directed travel away from the source) compared to surface feeding individuals that typically showed no change in behavior. Non-feeding whales also seemed to be affected by exposure. The authors indicate that disruption of feeding and displacement could impact individual fitness and health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case for the proposed SURTASS LFA sonar activities, particularly since unconsumed prey would likely still be available in the environment in most cases following the cessation of acoustic exposure. A determination of whether foraging disruptions incur fitness consequences will require information on or estimates of the energetic requirements of the individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Social Relationships. Social interactions between mammals can be affected by noise via the disruption of communication signals or by the displacement of individuals. Sperm whales responded to military sonar, apparently from a submarine, by dispersing from social aggregations, moving away from the sound source, remaining relatively silent, and becoming difficult to approach (Watkins *et al.,* 1985). In contrast, sperm whales in the Mediterranean that were exposed to submarine sonar continued calling (J. Gordon pers. comm. cited in Richardson *et al.,* 1995). However, social disruptions must be considered in context of the relationships that are affected. While some disruptions may not have deleterious effects, others, such as long-term or repeated disruptions of mother/calf pairs or interruption of mating behaviors, have the potential to affect the growth and survival or reproductive effort/success of individuals.

Vocalizations. (also see Masking Section)—Vocal changes in response to anthropogenic noise can occur across the repertoire of sound production modes used by marine mammals, such as whistling, echolocation click production, calling, and singing. Changes may result in response to a need to compete with an increase in background noise or may reflect an increased vigilance or startle response. For example, in the presence of low-frequency active sonar, humpback whales have been observed to increase the length of their ''songs'' (Miller *et al.,* 2000; Fristrup *et al.,* 2003), possibly due to the overlap in frequencies between the whale song and the low-frequency active sonar. A similar compensatory effect for the presence of low-frequency vessel noise has been suggested for right whales; right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007). Killer whales off the northwestern coast of the United States have been observed to increase the duration of primary calls once a threshold in observing vessel density (*e.g.,* whale watching) was reached, which has been suggested as a response to increased masking noise produced by the vessels (Foote *et al.,* 2004). In contrast, both sperm and pilot whales potentially ceased sound production during the Heard Island feasibility test (Bowles *et al.,* 1994), although it cannot be absolutely determined whether the inability to acoustically detect the animals was due to the cessation of sound production or the displacement of animals from the area.

Avoidance. Avoidance is the displacement of an individual from an area as a result of the presence of a sound. Richardson *et al.* (1995) noted that avoidance reactions are the most obvious manifestations of disturbance in marine mammals. Avoidance is qualitatively different from the flight response, but also differs in the magnitude of the response (*i.e.,* directed movement, rate of travel, etc.). Oftentimes, avoidance is temporary and animals return to the area once the noise has ceased. However, longer term displacement is possible and can lead to changes in abundance or distribution patterns of the species in the affected region if animals do not become acclimated to the presence of the chronic sound (Blackwell *et al.,* 2004; Bejder *et al.,* 2006; Teilmann *et al.,* 2006). Acute avoidance responses have been observed in captive porpoises and pinnipeds exposed to a number of different sound sources (Kastelein *et al.,* 2001; Finneran *et al.,* 2003; Kastelein *et al.,* 2006a; Kastelein *et al.,* 2006b). Short-term avoidance of seismic surveys, low-frequency emissions, and acoustic deterrents have also been noted in wild populations of odontocetes (Bowles *et al.,* 1994; Goold, 1996; 1998; Stone *et al.,* 2000; Morton and Symonds, 2002) and to some extent in mysticetes (Gailey *et al.,* 2007), while long-term or repetitive/chronic displacement for some dolphin groups and for manatees has been suggested to result from the presence of chronic vessel noise (Haviland-Howell *et al.,* 2007; Miksis-Olds *et al.,* 2007).

In 1998, the Navy conducted a Low Frequency Sonar Scientific Research Program (LFS SRP) specifically to study behavioral responses of several species of marine mammals to exposure to LF sound, including one phase that focused on the behavior of gray whales to low frequency sound signals. The objective of this phase of the LFS SRP was to determine whether migrating gray whales respond more strongly to received levels (RL), sound gradient, or distance from the source, and to compare whale avoidance responses to an LF source in the center of the migration corridor versus in the offshore portion of the migration corridor. A single source was used to broadcast LFA sonar sounds at RLs of 170–178 dB re 1μPa. The Navy reported that the whales showed some avoidance responses when the source was moored one mile (1.8 km) offshore, and located within in the migration path, but the whales returned to their migration path when they were a few kilometers beyond the source. When the source was moored two miles (3.7 km) offshore, responses were much less even when the source level was increased to achieve the same RLs in the middle of the migration corridor as whales received when the source was located within the migration corridor (Clark *et al.,* 1999). In addition, the researchers noted that the offshore whales did not seem to avoid the louder offshore source.

Also during the LFS SRP, researchers sighted numerous odontocete and pinniped species in the vicinity of the sound exposure tests with LFA sonar. The MF and HF hearing specialists present in the study area showed no immediately obvious responses or changes in sighting rates as a function of source conditions. Consequently, the researchers concluded that none of these species had any obvious behavioral reaction to LFA sonar signals at received levels similar to those that produced only minor short-term behavioral responses in the baleen whales (*i.e.,* LF hearing specialists). Thus, for odontocetes, the chances of injury and/or significant behavioral responses to SURTASS LFA sonar would be low given the MF/HF specialists' observed lack of response to LFA sounds during the LFS SRP and due to the MF/HF frequencies to which these animals are adapted to hear (Clark and Southall, 2009).

Maybaum (1993) conducted sound playback experiments to assess the effects of mid-frequency active sonar on humpback whales in Hawaiian waters. Specifically, she exposed focal pods to sounds of a 3.3-kHz sonar pulse, a sonar frequency sweep from 3.1 to 3.6 kHz, and a control (blank) tape while monitoring the behavior, movement, and underwater vocalizations. The two types of sonar signals differed in their effects on the humpback whales, but both resulted in avoidance behavior. The whales responded to the pulse by increasing their distance from the sound source and responded to the frequency sweep by increasing their swimming speeds and track linearity. In the Caribbean, sperm whales avoided exposure to mid-frequency submarine sonar pulses, in the range of 1000 Hz to 10,000 Hz (IWC 2005).

Kvadsheim *et al.,* (2007) conducted a controlled exposure experiment in which killer whales fitted with D-tags were exposed to mid-frequency active sonar (Source A: a 1.0 s upsweep 209 dB @1–2 kHz every 10 sec for 10 minutes; Source B: with a 1.0 s upsweep 197 dB @6–7 kHz every 10 sec for 10 min). When exposed to Source A, a tagged whale and the group it was traveling with did not appear to avoid the source. When exposed to Source B, the tagged whales, along with other whales that had been carousel feeding where killer whales cooperatively herd fish schools into a tight ball towards the surface and feed on the fish which have been stunned by tailslaps and subsurface feeding (Simila, 1997), ceased feeding during the approach of the sonar and moved rapidly away from the source. When exposed to Source B, Kvadsheim and his co-workers reported that a tagged killer whale seemed to try to avoid further exposure to the sound field by the following behaviors: Immediately swimming away (horizontally) from the source of the sound; engaging in a series of erratic and frequently deep dives that seemed to take it below the sound field; or swimming away while engaged in a series of erratic and frequently deep dives. Although the sample sizes in this study are too small to support statistical analysis, the behavioral responses of the orcas were consistent with the results of other studies.

In 2007, the first in a series of behavioral response studies (BRS) on deep diving odontocetes conducted by NMFS, Navy, and other scientists showed one beaked whale (*Mesoplodon densirostris*) responding to an MF active sonar playback. Tyack *et al.* (2011) indicates that the playback began when the tagged beaked whale was vocalizing at depth (at the deepest part of a typical feeding dive), following a previous control with no sound exposure. The whale appeared to stop clicking significantly earlier than usual, when exposed to mid-frequency signals in the 130–140 dB (rms) received level range. After a few more minutes of the playback, when the received level reached a maximum of 140–150 dB, the whale ascended on the slow side of normal ascent rates with a longer than normal ascent, at which point the exposure was terminated. The results are from a single experiment and a greater sample size is needed before robust and definitive conclusions can be drawn.

Tyack *et al.* (2011) also indicate that Blainville's beaked whales (a resident species within the Tongue of the Ocean, Bahamas study area) appear to be sensitive to noise at levels well below the onset of expected TTS (approximately 160 dB re: 1μPa at 1 m). This sensitivity was manifested by an adaptive movement away from a sound source. This response was observed irrespective of whether the signal transmitted was within the band width of MF active sonar, which suggests that beaked whales may not respond to the specific sound signatures. Instead, they may be sensitive to any pulsed sound from a point source in the frequency range of the MF active sonar transmission. The response to such stimuli appears to involve the beaked whale increasing the distance between it and the sound source.

Southall *et al.* (2016) indicates that results from Tyack *et al.* (2011); Miller *et al.* (2015), Stimpert *et al.* (2014), and DeRuiter *et al.* (2013) all demonstrate clear, strong, and pronounced but varied behavioral changes including sustained avoidance with associated energetic swimming and cessation of feeding behavior at quite low received levels (~100 to 135 dB re 1Pa) for exposures to simulated or active MF military sonars (1 to 8 kHz) with sound sources approximately 2 to 5 km away.

In the 2010 BRS study, researchers again used controlled exposure experiments (CEE) to carefully measure behavioral responses of individual animals to sound exposures of MF active sonar and pseudo-random noise. For each sound type, some exposures were conducted when animals were in a surface feeding (approximately 164 ft (50 m) or less) and/or socializing behavioral state and others while animals were in a deep feeding (greater than 164 ft (50 m)) and/or traveling mode. The researchers conducted the largest number of CEEs on blue whales (n=19) and of these, 11 CEEs involved exposure to the MF active sonar sound type. For the majority of CEE transmissions of either sound type, they noted few obvious behavioral responses detected either by the visual observers or on initial inspection of the tag data. The researchers observed that throughout the CEE transmissions, up to the highest received sound level (absolute RMS value approximately 160 dB re: 1μPa with signal-to-noise ratio values over 60 dB), two blue whales continued surface feeding behavior and remained at a range of around 3,820 ft (1,000 m) from the sound source (Southall *et al.,* 2011). In contrast, another blue whale (later in the day and greater than 11.5 mi (18.5 km; 10 nmi) from the first CEE location) exposed to the same stimulus (MFA) while engaged in a deep feeding/travel state exhibited a different response. In that case, the blue whale responded almost immediately following the start of sound transmissions when received sounds were just above ambient background levels (Southall *et al.,* 2011). The authors note that this kind of temporary avoidance behavior was not evident in any of the nine CEEs involving blue whales engaged in surface feeding or social behaviors, but was observed in three of the ten CEEs for blue whales in deep feeding/travel behavioral modes (one involving MFA sonar; two involving pseudo-random noise) (Southall *et al.,* 2011). The results of this study, as well as the results of the DeRuiter *et al.* (2013) study of Cuvier's beaked whales discussed above, further illustrate the importance of behavioral context in understanding and predicting behavioral responses.

Flight Response. A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presences of predators have occurred (Connor and Heithaus, 1996). Flight responses have been speculated as being a component of marine mammal strandings associated with MF active sonar activities (Evans and England, 2001). If marine mammals respond to Navy vessels that are transmitting active sonar in the same way that they might respond to a predator, their probability of flight responses should increase when they perceive that Navy vessels are approaching them directly, because a direct approach may convey detection and intent to capture (Burger and Gochfeld, 1981, 1990; Cooper, 1997, 1998). In addition to the limited data on flight response for marine mammals, there are examples of this response in terrestrial species. For instance, the probability of flight responses in Dall's sheep *Ovis dalli dalli* (Frid, 2001), hauled-out ringed seals *Phoca hispida* (Born *et al.,* 1999), Pacific brant (*Branta bernicl nigricans*), and Canada geese (*B. Canadensis*) increased as a helicopter or fixed-wing aircraft more directly approached groups of these animals (Ward *et al.,* 1999). Bald eagles (*Haliaeetus leucocephalus*) perched on trees alongside a river were also more likely to flee from a paddle raft when their perches were closer to the river or were closer to the ground (Steidl and Anthony, 1996).

Breathing. Variations in respiration naturally occur with different behaviors. Variations in respiration rate as a function of acoustic exposure can co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Mean exhalation rates of gray whales at rest and while diving were found to be unaffected by seismic surveys conducted adjacent to foraging grounds (Gailey *et al.,* 2007). Studies with captive harbor porpoises showed increased respiration rates upon introduction of acoustic alarms (Kastelein *et al.,* 2001; Kastelein *et al.,* 2006a) and emissions for underwater data transmission (Kastelein *et al.,* 2005). However, exposing the same acoustic alarm to a striped dolphin under the same conditions did not elicit a response (Kastelein *et al.,* 2006a), again highlighting the importance of understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure.

Continued Pre-disturbance Behavior and Habituation. Under some circumstances, some of the individual marine mammals that are exposed to active sonar transmissions will continue their normal behavioral activities. In other circumstances, individual animals will respond to sonar transmissions at lower received levels and move to avoid additional exposure or exposures at higher received levels (Richardson *et al.,* 1995).

It is difficult to distinguish between animals that continue their pre-disturbance behavior without stress responses, animals that continue their behavior but experience stress responses (that is, animals that cope with disturbance), and animals that habituate to disturbance (that is, they may have experienced low-level stress responses initially, but those responses abated over time). Watkins (1986) reviewed data on the behavioral reactions of fin, humpback, right and minke whales that were exposed to continuous, broadband low-frequency shipping and industrial noise in Cape Cod Bay. He concluded that underwater sound was the primary cause of behavioral reactions in these species of whales and that the whales responded behaviorally to acoustic stimuli within their respective hearing ranges. Watkins also noted that whales showed the strongest behavioral reactions to sounds in the 15 Hz to 28 kHz range, although negative reactions (avoidance, interruptions in vocalizations, etc.) were generally associated with sounds that were either unexpected, too loud, suddenly louder or different, or perceived as being associated with a potential threat (such as an approaching ship on a collision course). In particular, whales seemed to react negatively when they were within 100 m of the source or when received levels increased suddenly in excess of 12 dB relative to ambient sounds. At other times, the whales ignored the source of the signal and all four species habituated to these sounds. Nevertheless, Watkins concluded that whales ignored most sounds in the background of ambient noise, including sounds from distant human activities even though these sounds may have had considerable energies at frequencies well within the whales' range of hearing. Further, he noted that of the whales observed, fin whales were the most sensitive of the four species, followed by humpback whales; right whales were the least likely to be disturbed and generally did not react to low-amplitude engine noise. By the end of his period of study, Watkins (1986) concluded that fin and humpback whales have generally habituated to the continuous and broad-band noise of Cape Cod Bay while right whales did not appear to change their response. As mentioned above, animals that habituate to a particular disturbance may have experienced low-level stress responses initially, but those responses abated over time. In most cases, this likely means a lessened immediate potential effect from a disturbance. However, there is cause for concern where the habituation occurs in a potentially more harmful situation. For example, animals may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle *et al.,* 1993; Wiley *et al.,* 1995).

Aicken *et al.* (2005) monitored the behavioral responses of marine mammals to a new low-frequency active sonar system used by the British Navy (the United States Navy considers this to be a mid-frequency source as it operates at frequencies greater than 1,000 Hz). During those trials, fin whales, sperm whales, Sowerby's beaked whales, long-finned pilot whales, Atlantic white-sided dolphins, and common bottlenose dolphins were observed and their vocalizations were recorded. These monitoring studies detected no evidence of behavioral responses that the investigators could attribute to exposure to the low-frequency active sonar during these trials.

Southall *et al.* (2007) reviewed the available literature on marine mammal hearing and physiological and behavioral responses to human-made sound with the goal of proposing exposure criteria for certain effects. This peer-reviewed compilation of literature is very valuable, though Southall *et al.* (2007) note that not all data are equal: Some have poor statistical power, insufficient controls, and/or limited information on received levels, background noise, and other potentially important contextual variables. Such data were reviewed and sometimes used for qualitative illustration, but no quantitative criteria were recommended for behavioral responses. All of the studies considered, however, contain an estimate of the received sound level when the animal exhibited the indicated response.

In the Southall *et al.* (2007) publication, for the purposes of analyzing responses of marine mammals to anthropogenic sound and developing criteria, the authors differentiate between single pulse sounds, multiple pulse sounds, and non-pulse sounds. LFA sonar is considered a non-pulse sound. Southall *et al.* (2007) summarizes the studies associated with low-frequency, mid-frequency, and high-frequency cetacean and pinniped responses to non-pulse sounds, based strictly on received level, in Appendix C of their article (incorporated by reference and summarized in the following paragraphs).

The studies that address responses of low-frequency cetaceans to non-pulse sounds include data gathered in the field and related to several types of sound sources, including: Vessel noise, drilling and machinery playback, low-frequency M-sequences (sine wave with multiple phase reversals) playback, tactical low-frequency active sonar playback, drill ships, Acoustic Thermometry of Ocean Climate (ATOC) source, and non-pulse playbacks. These studies generally indicate no (or very limited) responses to received levels in the 90 to 120 dB re: 1 μPa range and an increasing likelihood of avoidance and other behavioral effects in the 120 to 160 dB re: 1 μPa range. As mentioned earlier, though, contextual variables play a very important role in the reported responses, and the severity of effects are not necessarily linear when compared to a received level. Also, few of the laboratory or field datasets had common conditions, behavioral contexts, or sound sources, so it is not surprising that responses differ.

The studies that address responses of mid-frequency cetaceans to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources including: Pingers, drilling playbacks, ship and ice-breaking noise, vessel noise, Acoustic Harassment Devices (AHDs), Acoustic Deterrent Devices (ADDs), MF active sonar, and non-pulse bands and tones. Southall *et al.* (2007) were unable to come to a clear conclusion regarding the results of these studies. In some cases, animals in the field showed significant responses to received levels between 90 and 120 dB re: 1 μPa, while in other cases these responses were not seen in the 120 to 150 dB re: 1 μPa range. The disparity in results was likely due to contextual variation and the differences between the results in the field and laboratory data (animals typically responded at lower levels in the field).

The studies that address responses of high-frequency cetaceans to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources including: Pingers, AHDs, and various laboratory non-pulse sounds. All of these data were collected from harbor porpoises. Southall *et al.* (2007) concluded that the existing data indicate that harbor porpoises are likely sensitive to a wide range of anthropogenic sounds at low received levels (approximately 90–120 dB re: 1 μPa), at least for initial exposures. All recorded exposures above 140 dB re: 1 μPa induced profound and sustained avoidance behavior in wild harbor porpoises (Southall *et al.,* 2007). Rapid habituation was noted in some but not all studies. There are no data to indicate whether other high-frequency cetaceans are as sensitive to anthropogenic sound as harbor porpoises.

The studies that address the responses of pinnipeds in water to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources including: AHDs, ATOC, various non-pulse sounds used in underwater data communication, underwater drilling, and construction noise. Few studies exist with enough information to include them in this analysis. The limited data suggest that exposure to non-pulse sounds between 90 and 140 dB re: 1 μPa generally do not result in strong behavioral responses of pinnipeds in water, but no data exist at higher received levels.

Potential Effects of Behavioral Disturbance

The different ways that marine mammals respond to sound are sometimes indicators of the ultimate effect that exposure to a given stimulus will have on the fitness (survival, reproduction, etc.) of an animal. There are few quantitative marine mammal data relating the exposure of marine mammals to sound to effects on reproduction or survival, though data exist for terrestrial species to which we can draw comparisons for marine mammals. Several authors have reported that disturbance stimuli cause animals to abandon nesting and foraging sites (Sutherland and Crockford, 1993); cause animals to increase their activity levels and suffer premature deaths or reduced reproductive success when their energy expenditures exceed their energy budgets (Daan *et al.,* 1996; Feare, 1976; Mullner *et al.,* 2004); or cause animals to experience higher predation rates when they adopt risk-prone foraging or migratory strategies (Frid and Dill, 2002). Each of these studies addressed the consequences of animals shifting from one behavioral state (*e.g.,* resting or foraging) to another behavioral state (*e.g.,* avoidance or escape behavior) because of human disturbance or disturbance stimuli.

One consequence of behavioral avoidance results in the altered energetic expenditure of marine mammals because energy is required to move and avoid surface vessels or the sound field associated with active sonar (Frid and Dill, 2002). Most animals can avoid that energetic cost by swimming away at slow speeds or speeds that minimize the cost of transport (Miksis-Olds, 2006), as has been demonstrated in Florida manatees (Miksis-Olds, 2006).

Those energetic costs increase, however, when animals shift from a resting state, which is designed to conserve an animal's energy, to an active state that consumes energy the animal would have conserved had it not been disturbed. Marine mammals that have been disturbed by anthropogenic noise and vessel approaches are commonly reported to shift from resting to active behavioral states, which would imply that they incur an energy cost.

Morete *et al.,* (2007) reported that undisturbed humpback whale cows that were accompanied by their calves were frequently observed resting while their calves circled them (milling). When vessels approached, the amount of time cows and calves spent resting and milling, respectively, declined significantly. These results are similar to those reported by Scheidat *et al.* (2004) for the humpback whales they observed off the coast of Ecuador.

Constantine and Brunton (2001) reported that bottlenose dolphins in the Bay of Islands, New Zealand engaged in resting behavior just five percent of the time when vessels were within 300 m, compared with 83 percent of the time when vessels were not present. However, Heenehan *et al.* (2016) report that results of a study of the response of Hawaiian spinner dolphins to human disturbance suggest that the key factor is not the sheer presence or magnitude of human activities, but rather the directed interactions and dolphin-focused activities that elicit responses from dolphins at rest. This information again illustrates the importance of context in regard to whether an animal will respond to a stimulus. Miksis-Olds (2006) and Miksis-Olds *et al.* (2005) reported that Florida manatees in Sarasota Bay, Florida, reduced the amount of time they spent milling and increased the amount of time they spent feeding when background noise levels increased. Although the acute costs of these changes in behavior are not likely to exceed an animal's ability to compensate, the chronic costs of these behavioral shifts are uncertain.

Attention is the cognitive process of selectively concentrating on one aspect of an animal's environment while ignoring other things (Posner, 1994). Because animals (including humans) have limited cognitive resources, there is a limit to how much sensory information they can process at any time. The phenomenon called ''attentional capture'' occurs when a stimulus (usually a stimulus that an animal is not concentrating on or attending to) ''captures'' an animal's attention. This shift in attention can occur consciously or unconsciously (*e.g.,* when an animal hears sounds that it associates with the approach of a predator) and the shift in attention can be sudden (Dukas, 2002; van Rij, 2007). Once a stimulus has captured an animal's attention, the animal can respond by ignoring the stimulus, assuming a ''watch and wait'' posture, or treating the stimulus as a disturbance and responding accordingly, which includes scanning for the source of the stimulus or ''vigilance'' (Cowlishaw *et al.,* 2004).

Vigilance is normally an adaptive behavior that helps animals determine the presence or absence of predators, assess their distance from conspecifics, or attend to cues from prey (Bednekoff and Lima, 1998; Treves, 2000). Despite those benefits, vigilance comes at a cost; when animals focus their attention on specific environmental cues, they are not attending to other activities, such as foraging. These costs have been documented best in foraging animals, where vigilance has been shown to substantially reduce feeding rates (Saino, 1994; Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002). Animals will spend more time being vigilant, which may translate to less time foraging or resting, when disturbance stimuli approach them more directly, remain at closer distances, have a greater group size (*e.g.,* multiple surface vessels), or when they co-occur with times that an animal perceives increased risk (*e.g.,* when they are giving birth or accompanied by a calf). Most of the published literature suggests that direct approaches will increase the amount of time animals will dedicate to being vigilant. An example of this concept with terrestrial species involved bighorn sheep and Dall's sheep, which dedicated more time to being vigilant, and less time resting or foraging, when aircraft made direct approaches over them (Frid, 2001). Vigilance has also been documented in pinnipeds at haul out sites where resting may be disturbed when seals become alerted and/or flush into the water due to a variety of disturbances, which may be anthropogenic (noise and/or visual stimuli) or due to other natural causes such as other pinnipeds (Richardson *et al.,* 1995; Southall *et al.,* 2007; VanBlaricom, 2010; and Lozano and Hente, 2014).

Several authors have established that long-term and intense disturbance stimuli can cause population effects by reducing the physical condition of individuals that have been disturbed, followed by reduced reproductive success, reduced survival, or both (Daan *et al.,* 1996; Madsen, 1994; White, 1985). For example, Madsen (1994) reported that pink-footed geese (*Anser brachyrhynchus*) in undisturbed habitat gained body mass and had about a 46 percent reproductive success rate compared with geese in disturbed habitat (being consistently scared off the fields on which they were foraging) which did not gain mass and had a 17 percent reproductive success rate. Similar reductions in reproductive success have been reported for other non-marine mammal species; for example, mule deer (*Odocoileus hemionus*) disturbed by all-terrain vehicles (Yarmoloy *et al.,* 1988), caribou (*Rangifer tarandus caribou*) disturbed by seismic exploration blasts (Bradshaw *et al.,* 1998), and caribou disturbed by low-elevation military jet flights (Luick *et al.,* 1996; Harrington and Veitch, 1992). Similarly, a study of elk (*Cervus elaphus*) that were disturbed experimentally by pedestrians concluded that the ratio of young to mothers was inversely related to disturbance rate (Phillips and Alldredge, 2000).

The primary mechanism by which increased vigilance and disturbance appear to affect the fitness of individual animals is by disrupting an animal's time budget, reducing the time they might spend foraging and resting (which increases an animal's activity rate and energy demand while decreasing their caloric intake/energy). As an example of this concept with terrestrial species involved, a study of grizzly bears (*Ursus horribilis*) reported that bears disturbed by hikers reduced their energy intake by an average of 12 kilocalories/min (50.2 $\times 10^3$ kiloJoules/min), and spent energy fleeing or acting aggressively toward hikers (White *et al.,* 1999). Alternately, Ridgway *et al.,* (2006) reported that increased vigilance in captive bottlenose dolphins exposed to sound over a five-day period in open-air, open-water enclosures in San Diego Bay did not cause any sleep deprivation or stress effects such as changes in cortisol or epinephrine levels.

On a related note, many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hr cycle). Behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are more likely to be significant for fitness if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly significant unless it could directly affect reproduction or survival (Southall *et al.,* 2007). It is important to note the difference between behavioral reactions lasting or recurring over multiple days and anthropogenic activities lasting or recurring over multiple days. For example, at-sea SURTASS LFA sonar missions last for multiple days, but this does not necessarily mean individual animals will be exposed to those exercises for multiple days or exposed in a manner that would result in a sustained behavioral response.

In order to understand how the effects of activities may or may not impact species and stocks of marine mammals, it is necessary to understand not only what the likely disturbances are going to be, but how those disturbances are likely to affect the reproductive success and survivorship of individuals, and then how those impacts to individuals translate to population-level effects. Following on the earlier work of a committee of the U.S. National Research Council (NRC, 2005), an effort by New *et al.* (2014) termed ''Potential Consequences of Disturbance (PCoD)'' outlined an updated conceptual model of the relationships linking disturbance to changes in behavior and physiology, health, vital rates, and population dynamics. In this framework, behavioral and physiological changes can have direct (acute) effects on vital rates, such as when changes in habitat use or increased stress levels raise the probability of mother-calf separation or predation; they can have indirect and long-term (chronic) effects on vital rates, such as when changes in time/energy budgets or increased disease susceptibility affect health, which then later affect vital rates; or they can have no effect to vital rates. In addition to outlining this general framework and compiling the relevant literature that supports it, the authors chose four example species for which extensive long-term monitoring data exist (southern elephant seals, North Atlantic right whales, Ziphidae beaked whales, and bottlenose dolphins) and developed state-space energetic models that can be used to effectively forecast longer-term, population-level impacts to these species from behavioral changes. While these are very specific models with specific data requirements that cannot yet be applied to project-specific risk assessments or for the majority of species, they are a critical first step towards being able to quantify the likelihood of a population level effect.

Stranding and Mortality

The definition for a stranding under the MMPA is that (A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance (16 U.S.C. 1421h).

Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series. However, the cause or causes of most strandings are unknown (Geraci *et al.,* 1976; Eaton, 1979; Odell *et al.,* 1980; Best, 1982). Numerous studies suggest that the physiology, behavior, habitat relationships, age, or condition of cetaceans may cause them to strand or might pre-dispose them to strand when exposed to another phenomenon. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Chroussos, 2000; Creel, 2005; Fair and Becker, 2000; Moberg, 2000; Relyea, 2005a; 2005b, Romero, 2004; Sih *et al.,* 2004).

In 1992, Congress amended the MMPA to establish the Marine Mammal Health and Stranding Response Program (MMHSRP) under authority of NMFS. The MMHSRP was created out of concern over marine mammal mortalities, to formalize the stranding response process, to focus efforts being initiated by numerous local stranding organizations, and as a result of public concern.

Strandings Associated With Active Sonar

Several sources have published lists of mass stranding events of cetaceans in an attempt to identify relationships between those stranding events and military active sonar (Hildebrand, 2004; IWC, 2005; Taylor *et al.,* 2004). For example, based on a review of stranding records between 1960 and 1995, the International Whaling Commission (2005) concluded that, out of eight stranding events reported from the mid-1980s to the summer of 2003, most had been coincident with the use of tactical MF active sonar and most involved beaked whales. Differences between tactical MF sonar and SURTASS LFA sonar, as well as the potential for strandings due to SURTASS LFA sonar, are addressed further below.

To date, there have been five stranding events coincident with military MF active sonar use for which NMFS and Navy concluded the exposure to sonar was likely a contributing factor to strandings: Greece (1996); the Bahamas (2000); Madeira (2000); Canary Islands (2002); and Spain (2006). NMFS refers the reader to DoN (2013) for a report on these strandings associated with Navy sonar activities; Cox *et al.* (2006) for a summary of common features shared by the strandings events in Greece (1996), Bahamas (2000), Madeira (2000), and Canary Islands (2002); and Fernandez *et al.,* (2005) for an additional summary of the Canary Islands 2002 stranding event. Additionally, in 2004, during the Rim of the Pacific (RIMPAC) exercises, between 150 and 200 usually pelagic melon-headed whales occupied the shallow waters of the Hanalei Bay, Kaua'i, Hawaii for over 28 hours. NMFS determined that the mid-frequency sonar was a plausible, if not likely, contributing factor in what may have been a confluence of events that led to the Hanalei Bay stranding. A number of other stranding events coincident with the operation of MF active sonar including the death of beaked whales or other species (minke whales, dwarf sperm whales, pilot whales) have been reported; however, the majority have not been investigated to the degree necessary to determine the cause of the stranding. Only one of the events listed above was coincident with an exercise conducted by the U.S. Navy.

Potential for Stranding From LFA Sonar

There is no empirical evidence of strandings of marine mammals associated with the employment of SURTASS LFA sonar since its use began in the early 2000s. Moreover, both the system acoustic characteristics and the operational parameters differ between SURTASS LFA sonar and MFA sonars. SURTASS LFA sonars use frequencies generally below 1,000 Hz, with relatively long signals (pulses) on the order of 60 sec; while MF sonars use frequencies greater than 1,000 Hz, with relatively short signals on the order of 1 sec. SURTASS LFA sonars involve use of one slower-moving vessel operating far from shore, as opposed to the faster-moving, multi-vessel MFA sonar training scenarios operating in closer proximity to shore that have been co-incident with strandings.

As discussed previously, Cox *et al.* (2006) provided a summary of common features shared by the stranding events related to MF sonar in Greece (1996), Bahamas (2000), and Canary Islands (2002). These included deep water close to land (such as offshore canyons), presence of an acoustic waveguide (surface duct conditions), and periodic sequences of transient pulses (*i.e.,* rapid onset and decay times) generated at depths less than 32.8 ft (10 m) by sound sources moving at speeds of 2.6 m/s (5.1 knots) or more during sonar operations (D'Spain *et al.,* 2006). These features are not similar to LFA sonar activities. First, the Navy will not operate SURTASS LFA sonar such that RLs are greater than 180 dB within 22 km of any coastline, ensuring that sound levels are at reduced levels at a sufficient distance from land. Secondly, when transmitting, the ship typically operates at 1.5–2.5 m/s (3–5 knots), speeds that are less than those found in Cox *et al.* (2009). Finally, the center of the vertical line array (source) is at a depth of approximately 400 ft (121.9 m), reducing the sounds that are transmitted at depths above 32.8 ft (10 m). For these reasons, SURTASS LFA sonar cannot be operated in deep water that is close to land. Also, the LFA sonar signal is transmitted at depths well below 32.8 ft (10 m). While there was an LF component in the Greek stranding in 1996, only MF components were present in the strandings in the Bahamas in 2000, Madeira in 2000, and the Canary Islands in 2002. The International Council for the Exploration of the Sea (ICES) in its ''Report of the Ad-Hoc Group on the Impacts of Sonar on Cetaceans and Fish'' raised the same issues as Cox *et al.,* (2006) stating that the consistent association of MF sonar in the Bahamas, Madeira, and Canary Islands strandings suggest that it was the MF component, not the LF component, in the NATO sonar that triggered the Greek stranding of 1996 (ICES, 2005). The ICES (2005) report concluded that no strandings, injury, or major behavioral change have been associated with the exclusive use of LF sonar.

Potential Effects of Vessel Movement and Collisions

Vessel movement in the vicinity of marine mammals has the potential to result in either a behavioral response or a direct physical interaction. Both scenarios are discussed below.

Behavioral Responses to Vessels (Movement and Noise)

There are limited data concerning marine mammal behavioral responses to vessel traffic and vessel noise, and a lack of consensus among scientists with respect to what these responses mean or whether they result in short-term or long-term adverse effects. As discussed previously, behavioral responses are context-dependent, complex, and influenced to varying degrees by a number of factors. For example, an animal may respond differently to a sound emanating from a ship that is moving towards the animal than it would to an identical received level coming from a vessel that is moving away, or to a ship traveling at a different speed or at a different distance from the animal. In cases where vessels actively approach marine mammals (*e.g.,* whale watching or dolphin watching boats), scientists have documented that animals exhibit altered behavior such as increased swimming speed, erratic movement, and active avoidance behavior (Bursk, 1983; Acevedo, 1991; Baker and MacGibbon, 1991; Trites and Bain, 2000; Constantine *et al.,* 2003), reduced blow interval (Ritcher *et al.,* 2003), disruption of normal social behaviors (Lusseau, 2003; 2006), and the shift of behavioral activities which may increase energetic costs (Constantine *et al.,* 2003; 2004; Heenehan *et al.,* 2016)). However, at greater distances, the nature of vessel movements could also potentially have no, or very little, effect on the animal's response to the sound. In those cases where there is a busy shipping lane or a large amount of vessel traffic, marine mammals may experience acoustic masking (Hildebrand, 2005) if they are present in the area (*e.g.,* killer whales in Puget Sound; Foote *et al.,* 2004; Holt *et al.,* 2008). In any case, a full description of the suite of factors that elicited a behavioral response would require a mention of the vicinity, speed and movement of the vessel, and other factors. A detailed review of marine mammal reactions to ships and boats is available in Richardson *et al.* (1995). For each of the marine mammal taxonomy groups, Richardson *et al.* (1995) provides the following assessment regarding cetacean reactions to vessel traffic:

Toothed whales: Toothed whales sometimes show no avoidance reaction to vessels, and may even approach them; however, avoidance can occur, especially in response to vessels of types used to chase or hunt the animals. Such avoidance may cause temporary displacement, but we know of no clear evidence of toothed whales abandoning significant parts of their range because of vessel traffic.

Baleen whales: Baleen whales seem to ignore low-level sounds from distant or stationary vessels, and some whales even approach the sources of these sounds. When approached slowly and non-aggressively, whales often exhibit slow and inconspicuous avoidance maneuvers. However, in response to strong or rapidly changing vessel noise, baleen whales often interrupt their normal behavior and swim rapidly away, and avoidance is especially strong when a boat heads directly toward the whale.

Behavioral responses to stimuli are complex and influenced to varying degrees by a number of factors, such as species, behavioral contexts, geographical regions, source characteristics (moving or stationary, speed, direction, etc.), prior experience of the animal and physical status of the animal. For example, studies have shown that beluga whales' reactions varied when exposed to vessel noise and traffic. In some cases, naive beluga whales exhibited rapid swimming from ice-breaking vessels up to 80 km (49.7 mi) away, and showed changes in surfacing, breathing, diving, and group composition in the Canadian high Arctic where vessel traffic is rare (Finley *et al.,* 1990). In other cases, beluga whales were more tolerant of vessels, but responded differentially to certain vessels and operating characteristics by reducing their calling rates (especially older animals) in the St. Lawrence River where vessel traffic is common (Blane and Jaakson, 1994). In Bristol Bay, Alaska, beluga whales continued to feed when surrounded by fishing vessels and resisted dispersal even when purposefully harassed (Fish and Vania, 1971).

In reviewing more than 25 years of whale observation data, Watkins (1986) concluded that whale reactions to vessel traffic were ''modified by their previous experience and current activity: habituation often occurred rapidly, attention to other stimuli or preoccupation with other activities sometimes overcame their interest or wariness of stimuli.'' Watkins noticed that over the years of exposure to ships in the Cape Cod area, minke whales changed from frequent positive interest (*e.g.,* approaching vessels) to generally uninterested reactions; fin whales changed from mostly negative (*e.g.,* avoidance) to uninterested reactions; right whales apparently continued the same variety of responses (negative, uninterested, and positive responses) with little change; and humpbacks dramatically changed from mixed responses that were often negative to reactions that were often strongly positive. Watkins (1986) summarized that whales near shore generally have become less wary of boats and their noises, and they have appeared to be less easily disturbed, even in regions with low vessel traffic. In locations with intense shipping and repeated approaches by boats (such as the whale-watching areas), more whales had positive reactions to familiar vessels, and they also occasionally approached other boats and yachts in the same ways.

Although the radiated sound from Navy vessels will be audible to marine mammals over a large distance, it is unlikely that animals will respond behaviorally (in a manner that NMFS would consider indicative of harassment under the MMPA) to low-level distant ship noise as the animals in the area are likely to be habituated to such noises (Nowacek *et al.,* 2004). In addition, given the ship movement in the water and the fact that it is not idle in one spot nor necessarily encircling to contain animals, a significant disruption of normal behavioral pattern that would make ship movements rise to the level of take by Level B harassment is unlikely. In light of these facts, NMFS does not expect the movements of the Navy's SURTASS LFA sonar vessels to result in take by Level B harassment.

Vessel Strike

Ship strikes of cetaceans can cause immediate death or major injury, which may eventually lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could be cut by a vessel's propeller. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Vanderlaan and Taggart, 2007).

The most vulnerable marine mammals are those that spend extended periods of time at the surface, often to restore oxygen levels within their tissues after deep dives (*e.g.,* the sperm whale). In addition, some large, slow moving baleen whales, such as the North Atlantic right whale, seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek *et al.,* 2004). Some smaller marine mammals (*e.g.,* bottlenose dolphin) move quickly through the water column and purposefully approach ships to ride the bow wave of large ships without any injury.

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike results in death (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Jensen and Silber, 2003; Vanderlaan and Taggart, 2007). In assessing records in which vessel speed was known, Laist *et al.* (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision, with most deaths occurring when a vessel was traveling in excess of 14.9 mph (24.1 km/hr;13 kts).

Jensen and Silber (2004) detailed 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. Of these, vessel speed at the time of collision was reported for 58 cases. Of these cases, 39 (or 67 percent) resulted in serious injury or death (19 of those resulted in serious injury as determined by blood in the water; propeller gashes or severed tailstock, and fractured skull, jaw, vertebrae; hemorrhaging; massive bruising or other injuries noted during necropsy and 20 resulted in death). Operating speeds of vessels that struck various species of large whales ranged from 2 to 51 kts, with the majority (79 percent) of these strikes occurring at speeds of 13 kts or greater. The average speed that resulted in serious injury or death was 18.6 kts. Pace and Silber (2005) found that the probability of death or serious injury increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 percent to 75 percent as vessel speed increased from 10 to 14 kts, and exceeded 90 percent at 17 kts. Higher speeds during collisions result in greater force of impact, but higher speeds also appear to increase the chance of severe injuries or death by pulling whales toward the vessel. While modeling studies have suggested that hydrodynamic forces pulling whales toward the vessel hull increase with increasing vessel speed (Clyne, 1999; Knowlton *et al.,* 1995), this is inconsistent with Silber *et al.* (2010), which demonstrated that there is no such relationship (*i.e.,* hydrodynamic forces are independent of speed).

The Jensen and Silber (2004) report notes that the database represents a minimum number of collisions, because the vast majority probably goes undetected or unreported. In contrast, Navy vessels are likely to detect any strike that does occur, and they are required to report all ship strikes involving marine mammals. Overall, the percentage of Navy vessel traffic relative to overall large shipping vessel traffic is very small (on the order of two percent). Moreover, as mentioned previously, there are only four SURTASS LFA sonar vessels operating worldwide, which would equate to an extremely small percentage of the total vessel traffic.

The Navy's operation of up to four SURTASS LFA sonar vessels worldwide is extremely small in scale compared to the number of commercial ships transiting at higher speeds in the same areas on an annual basis. The probability of vessel and marine mammal interactions occurring during SURTASS LFA sonar activities is unlikely due to the surveillance vessel's slow operational speed, which is typically 3.4 mph (5.6 km/hr; 3 kts). Outside of SURTASS LFA sonar activities, each vessel's cruising speed would be a maximum of approximately 11.5 to 14.9 mph (18.5 to 24.1 km/hr; 10

to 13 kts) which is generally below the speed at which studies have noted reported increases of marine mammal injury or death (Laist *et al.,* 2001). Second, NMFS proposes to require the Navy to restrict the operation of SURTASS LFA vessels at a distance of 1 km (0.62 mi; 0.54 nmi) seaward of the outer perimeter of any OBIA designated for marine mammals during a specified period, further minimizing the potential for marine mammal interactions. Also, the Navy would not operate SURTASS LFA vessels a distance of 22 km (13. mi; 12 nmi) or less of any coastline, including islands, thus operating in offshore coastal areas where lower densities of marine mammals would minimize potential for vessel interactions.

As a final point, the SURTASS LFA surveillance vessels have a number of other advantages for avoiding ship strikes as compared to most commercial merchant vessels, including the following: The catamaran-type split hull shape and enclosed propeller system of the Navy's T–AGOS ships; the bridge of T–AGOS ships positioned forward of the centerline, offering good visibility ahead of the bow and good visibility aft to visually monitor for marine mammal presence; lookouts posted during activities scan the ocean for marine mammals and must report visual alerts of marine mammal presence to the Deck Officer; lookouts receive extensive training that covers the fundamentals of visual observing for marine mammals and information about marine mammals and their identification at sea; and SURTASS LFA vessels travel at low speed (3–4 kts (approximately 3.4 mph; 5.6 km/hr)) with deployed arrays. Lastly, the use of passive and active acoustic monitoring for marine mammals as mitigation measures to monitor for marine mammals along with visual marine mammal observers would detect cetaceans well in advance of any potential ship strike distance (for a thorough discussion of mitigation measures, please see the Proposed Mitigation section later in this document).

Due to the reasons described above (low probability of vessel/marine mammal interactions; relatively slow vessel speeds; and high probability of detection due to applied mitigation measures), the Navy and NMFS have determined that take of marine mammals by vessel strike is highly unlikely. Therefore, the Navy has not requested any take of marine mammals due to ship strike, nor is NMFS considering any authorization of take due to ship strike.

Results From Past Monitoring

From the commencement of SURTASS LFA sonar use in 2002 through the present, neither operation of LFA sonar, nor operation of the T–AGOS vessels, has been associated with any mass or individual strandings of marine mammals temporally or spatially. In addition, the Navy's required monitoring reports indicate that there have been no apparent avoidance reactions observed, and no takes by Level A harassment due to SURTASS LFA sonar since its use began in 2002. Lastly, monitoring reports from previous years of operation indicate that the Navy typically transmits SURTASS LFA sonar well below the authorized number of hours and the actual percentages of affected stocks are well below the 12 percent cap for Level B harassment for each stock. In summary, results of the analyses conducted for SURTASS LFA sonar and more than thirteen years of documented operational results support the determination that the only takes anticipated would be short-term Level B harassment of relatively small percentages of affected marine mammal stocks.

Effects on Marine Mammal Habitat and Prey

Based on the following information and the supporting information included in the Navy's application as well as the 2001; 2007; 2012; and 2015 NEPA documents, and 2016 DSEIS/SOEIS, NMFS has preliminarily determined that SURTASS LFA sonar activities are not likely to adversely impact marine mammal habitat. For reasons described above, unless the sound source is stationary and/or continuous over a long duration in one area, the effects of the introduction of sound into the environment are generally considered to have a less severe impact on marine mammal habitat than actions involving physical alteration of the habitat. Marine mammals may be temporarily displaced from areas where SURTASS LFA activities are occurring to avoid noise exposure (see above), but those areas themselves will not be altered and will likely be available for use again after the activities have ceased or moved out of the area.

The Navy's proposed SURTASS LFA sonar activities could potentially affect marine mammal habitat through the introduction of pressure and sound into the water column, which in turn could impact prey species of marine mammals.

Anticipated Impacts on Prey Species (Invertebrates and Fish)

Among invertebrates, only cephalopods (octopus and squid) and decapods (lobsters, shrimps, and crabs) are known to sense LF sound (Packard *et al.,* 1990; Budelmann and Williamson, 1994; Lovell *et al.,* 2005; Mooney *et al.,* 2010). Popper and Schilt (2008) stated that, like fish, some invertebrate species produce sound, possibly using it for communications, territorial behavior, predator deterrence, and mating. Well known sound producers include the lobster (*Panulirus* spp.) (Latha *et al.,* 2005), and the snapping shrimp (*Alpheus heterochaelis*) (Herberholz and Schmitz, 2001).

Andre *et al.* (2011) exposed four cephalopod species (*Loligo vulgaris, Sepia officinalis, Octopus vulgaris,* and *Ilex coindetii)* to two hours of continuous sound from 50 to 400 Hz at 157 ± 5 dB re: 1 μPa. They reported lesions to the sensory hair cells of the statocysts of the exposed animals that increased in severity with time, suggesting that cephalopods are particularly sensitive to low-frequency sound. The Navy notes in the DSEIS/SOEIS (Chapter 4) that a follow-on study was conducted with Mediterranean and European squid (*Octopus vulgaris,* and *Ilex coindetii*) that included controls (Solé *et al.,* 2013), which found a similar result as Andre *et al.* (2011) with permanent and substantial alteration of the sensory hair cells of the statocysts. Aguilar de Soto *et al.* (2013) exposed New Zealand scallop larvae (*Pecten novaezeandiae*) to recorded signals from a seismic airgun survey every three seconds for up to 70 hours. They found a delay in development and malformations of the larvae in the noise-exposed samples. However, SURTASS LFA sonar has none of the same characteristics as the acoustic sources used in these studies. The time sequence of exposure from low-frequency sources in the open ocean would be about once every 10 to 15 min for SURTASS LFA. Therefore, the study's sound exposures were longer in duration and higher in energy than any exposure a marine mammal would likely ever receive and acoustically very different than a free field sound to which animals would be exposed in the real world. SURTASS LFA sonar activities would only be expected to have a lasting impact on these animals if they are within a few tens of meters from the source. In conclusion, NMFS does not expect any short- or long-term effects to marine mammal food resources from SURTASS LFA sonar activities.

The Navy's DSEIS/SOEIS includes a detailed discussion of the effects of active sonar on marine fish and several studies on the effects of both Navy sonar and seismic airguns that are relevant to potential effects of SURTASS LFA sonar on *osteichthyes* (bony fish). In the most pertinent of these, the Navy funded independent scientists to analyze the effects of SURTASS LFA sonar on fish (Popper *et al.,* 2007; Halvorsen *et al.,* 2006) and on the effects of SURTASS LFA sonar on fish physiology (Kane *et al.,* 2010).

Several studies on the effects of SURTASS LFA sonar sounds on three species of fish (rainbow trout, channel catfish, and hybrid sunfish) examined long-term effects on sensory hair cells of the ear. In all species, even up to 96 hours post-exposure, there were no indications of damage to sensory cells (Popper *et al.,* 2005a, 2007; Halvorsen *et al.,* 2006). Recent results from direct pathological studies of the effects of LFA sounds on fish (Kane *et al.,* 2010) provide evidence that SURTASS LFA sonar sounds at relatively high received levels (up to 193 dB re: 1 μPa at 1 m) have no pathological effects or short-or long-term effects to ear tissue on the species of fish that have been studied.

Proposed Mitigation

Least Practicable Adverse Impact Standard Discussion

Under section 101(a)(5)(A) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for subsistence uses (''least practicable adverse impact''). NMFS does not have a regulatory definition for least practicable adverse impact. The FY 2004 NDAA amended the MMPA as it relates to military readiness activities and the incidental take authorization process such that ''least practicable adverse impact'' shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the ''military readiness activity.''

In *Conservation Council for Hawaii* v. *National Marine Fisheries Service,* 97 F. Supp. 3d 1210, 1229 (D. Haw. Mar. 31, 2015), the court stated that NMFS ''appear[s] to think [it] satisf[ies] the statutory 'least practicable adverse impact' requirement with a 'negligible impact' finding.'' More recently, expressing similar concerns in a challenge to our last SURTASS LFA sonar incidental take rule, the Ninth Circuit Court of Appeals in *Natural Resources Defense Council* v. *Pritzker,* 828 F.3d 1125, 1134 (9th Cir. July 15, 2016), stated, ''Compliance with the 'negligible impact' requirement does not mean there [is] compliance with the 'least practicable adverse impact standard [. . .] .'' As the Ninth Circuit noted in its opinion, however, the court was interpreting the statute without the benefit of NMFS' formal interpretation. We state here explicitly, as we have said in the past, that NMFS is in full agreement that the ''negligible impact'' and ''least practicable adverse impact'' requirements are distinct, even though both statutory standards refer to species and stocks. With that in mind, we provide further explanation of our interpretation of least practicable adverse impact, and explain what distinguishes it from the negligible impact standard. This discussion is consistent with, and expands upon, previous rules we have issued.

Before NMFS can issue incidental take regulations under section 101(a)(5)(A) of the MMPA, it must make a finding that the total taking will have a ''negligible impact'' on the affected ''species or stocks'' of marine mammals. NMFS' and U.S. Fish and Wildlife Service's joint implementing regulations for section 101(a)(5)(A) define ''negligible impact'' as ''an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.'' (50 CFR 216.103 and 50 CFR 18.27(c)) Recruitment (*i.e.,* reproduction) and survival rates are used to determine population growth rates [1] and, therefore are considered in evaluating population level impacts.

As we stated in the preamble to the final rule for the joint implementing regulations, not every population-level impact violates the negligible impact requirement. The negligible impact standard does not require a finding that the anticipated take will have ''no effect'' on population numbers or growth rates: ''The statutory standard does not require that the same recovery rate be maintained, rather that no significant effect on annual rates of recruitment or survival occurs [. . .]. [T]he key factor is the significance of the level of impact on rates of recruitment or survival.'' (See 54 FR 40338, 40341–42 (September 29, 1989))

While some level of impact on population numbers or growth rates of a species or stock may occur and still satisfy the negligible impact requirement—even without consideration of mitigation—the least practicable adverse impact provision separately requires NMFS to prescribe the means of ''effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance [. . .].'' [2] [3]

The negligible impact and least practicable adverse impact standards in the statute share a common reference to ''species or stocks.'' A ''species'' is defined as a group of animals or plants that are similar and can produce young animals or plants: A group of related animals or plants that is smaller than a genus *http://www.merriam-webster.com/dictionary/species*. ''Population stock'' or ''stock'' means a group of marine mammals of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature (16 U.S.C. 1362(11)). We believe those terms indisputably refer to populations of animals, aFurther nd that it is therefore appropriate to view both MMPA provisions as having a population-level focus. This is consistent with both the language of the statute and Congress's overarching conservation objective in enacting the MMPA. See 16 U.S.C. 1361 (Congress's findings reflecting policy concerns about the extinction or depletion of certain marine mammal species or stocks and the goal of ensuring they are functioning elements of their ecosystems).

Recognizing this common focus of the two provisions on ''species or stock'' does not mean we conflate the standards; despite some common statutory language, we recognize the two provisions are different in other ways and have different functions.[4] First, a negligible impact finding is required before NMFS can issue an incidental take authorization. Although it is

[1] A growth rate can be positive, negative, or flat.

[2] For purposes of this discussion we omit reference to the language in the standard for least practicable adverse impact that says we also must mitigate for subsistence impacts because they are not at issue in this action.

[3] NMFS' incidental take actions routinely refer to the least practicable adverse impact requirement in shorthand as ''mitigation,'' a concept that broadly encompasses measures or practices that are reasonably designed to avoid, reduce, or minimize impacts.

[4] See also *CBD* v. *Salazar*, 695 F.3d 893 (9th Cir. 2012) (finding that some overlap between FWS' factors for determining negligible impact and small numbers was not an improper conflation of the two standards where the agency also considered other factors in reaching its conclusions).

acceptable to use mitigation to reach a negligible impact finding (50 CFR 216.104(c)), no amount of mitigation can enable NMFS to issue an incidental take authorization for an activity that still would not meet the negligible impact standard. Moreover, even where NMFS can reach a negligible impact finding—which we emphasize does allow for the possibility of some ''negligible'' population-level impact—the agency must still prescribe practicable measures that will effect the least amount of adverse impact upon the affected species or stock.

Further, section 101(a)(5)(A)(i)(II) requires NMFS to issue, in conjunction with its authorization, binding—and enforceable—restrictions (in the form of regulations) setting forth how the activity must be conducted, thus ensuring the activity has the ''least practicable adverse impact'' on the affected species or stocks. In situations where mitigation is needed to reach a negligible impact determination, section 101(a)(5)(A)(i)(II) also provides a mechanism for ensuring compliance with the ''negligible impact'' requirement. Finally, we also reiterate that the ''least practicable adverse impact'' standard requires mitigation for marine mammal habitat, with particular attention to rookeries, mating grounds, and other areas of similar significance, and for mitigating subsistence impacts; whereas the negligible impact standard is concerned with conclusions about the impact of an activity on the affected populations.[5]

In *NRDC* v. *Pritzker,* the court stated, ''[t]he statute is properly read to mean that even if population levels are not threatened *significantly,* still the agency must adopt mitigation measures aimed at protecting *marine mammals* to the greatest extent practicable in light of military readiness needs.'' *Id.* At 1134 (emphasis added). This statement is consistent with our understanding stated above that even when the effects of an action satisfy the negligible impact standard (*i.e.,* in the court's words, ''population levels are not threatened significantly''), still the agency must prescribe mitigation under the least practicable adverse impact standard. However, as the statute indicates, the focus of both standards is ultimately the impact on the affected ''species or stock,'' and not solely focused on/directed at the impact on individual marine mammals.

We have carefully reviewed and considered the Ninth Circuit's opinion in *NRDC* v. *Pritzker* in its entirety. While the court's reference to ''marine mammals'' rather than ''marine mammal species or stocks'' in the italicized language above might be construed as a holding that the least practicable adverse impact standard applies at the individual ''marine mammal'' level, *i.e.,* that NMFS must require mitigation to minimize impacts to each individual marine mammal unless impracticable, we believe such an interpretation reflects an incomplete appreciation of the court's holding. In our view, the opinion as a whole turned on the court's determination that NMFS had not given separate and independent meaning to the least practicable adverse impact standard apart from the negligible impact standard, and further that the court's use of the term ''marine mammals'' was not addressing the question of whether the standard applies to individual animals as opposed to the species or stock as a whole. We recognize that while consideration of mitigation can play a role in a negligible impact determination, consideration of mitigation extends beyond that analysis. In evaluating what mitigation is appropriate NMFS considers the impacts of the proposed action, the availability of measures to minimize those potential impacts, and the practicability of implementing those measures, as we describe below.

Implementation of Least Practicable Adverse Impact

Given this most recent court decision, we further clarify how we determine whether a measure or set of measures meets the ''least practicable adverse impact'' standard. Our evaluation of potential mitigation measures includes consideration of two primary factors:

(1) The manner in which, and the degree to which, implementation of the measure(s) is expected to reduce impacts to marine mammal species or stocks, their habitat, and their availability for subsistence uses (where relevant). Among other things, this analysis will consider the nature of the potential adverse impact (such as likelihood, scope, range), the likelihood that the measure will be effective if implemented; and the likelihood of successful implementation.

(2) The practicability of the measures for applicant implementation. Practicability of implementation may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity (16 U.S.C. 1371(a)(5)(A)(ii)).

While the language of the least practicable adverse impact standard calls for minimizing impacts to affected species or stocks, we recognize that the reduction of impacts to those species or stocks accrues through the application of mitigation measures that limit impacts to individual animals. Accordingly, NMFS' analysis will focus on measures designed to avoid or minimize impacts on marine mammals from activities that are likely to increase the probability or severity of population-level effects. While direct evidence of impacts to species or stocks from a specified activity is rarely available, and additional study is still needed to describe how specific disturbance events affect the fitness of individuals of certain species, there have been improvements in understanding the process by which disturbance effects are translated to the population. With recent scientific advancements (both marine mammal energetic research and the development of energetic frameworks), the relative likelihood or degree of impacts on species or stocks may often be inferred given a detailed understanding of the activity, the environment, and the affected species or stocks. This same information is used in the development of mitigation measures and helps us understand how mitigation measures contribute to lessening species or stock effects.

In the evaluation of specific measures, the details of the specified activity will necessarily inform each of the two factors and will be carefully considered to determine the types of mitigation that are appropriate under the least practicable adverse impact standard. The greater the likelihood that a measure will contribute to reducing the probability or severity of adverse impacts to the species or stock, the greater the weight that measure(s) is given when considered in combination with practicability to determine the appropriateness of the mitigation measure(s), and vice versa.

Below we discuss how these factors are considered.

1. *Reduction of adverse impacts to species or stock.* The emphasis given to a measure's ability to reduce the impacts on a species or stock considers the degree, likelihood, and context of the anticipated reduction of impacts to individuals as well as the status of the species or stock.

The ultimate impact on any individual from a disturbance event (which informs the likelihood of adverse species or stock-level effects) is dependent on the circumstances and associated contextual factors, such as duration of exposure to stressors. Though any proposed mitigation needs to be evaluated in the context of the specific activity and the species or stocks affected, measures with the following types of goals are often applied to reduce the likelihood or severity of adverse species or stock-level impacts: Avoiding or minimizing injury or mortality; limiting interruption of known feeding, breeding, mother/young, or resting behaviors; minimizing the abandonment of important habitat (temporally and spatially); minimizing the number of individuals subjected to these types of disruptions; and limiting degradation of habitat. Mitigating these types of effects is intended to reduce the likelihood that the activity will result in energetic or other types of impacts that are more likely to result in reduced reproductive success or survivorship. It is also important to consider the degree of impacts that were expected in the absence of mitigation in order to assess the added value of any potential measures.

The status of the species or stock is also relevant in evaluating the appropriateness of certain mitigation measures in the context of least practicable adverse impact. The following are examples of factors that may (either alone, or in combination) result in greater emphasis on the importance of a mitigation measure in reducing impacts on a species or stock: The stock is known to be decreasing or status is unknown, but believed to be declining; the known annual mortality (from any source) is approaching or exceeding the potential biological removal (PBR) level (as defined in 16 U.S.C. 1362(20)); the affected species or stock is a small, resident population; or the stock is involved in an unusual mortality event (UME) or has other known vulnerabilities, such as recovering from an oil spill.

Reduction of habitat impacts. Habitat mitigation, particularly as it relates to rookeries, mating grounds, and areas of similar significance, is also relevant and can include measures, such as reducing impacts of the activity on known prey utilized in the activity area or reducing impacts on physical habitat.

Likely effectiveness of the measure. We consider available information indicating the likelihood of any measure to accomplish its objective. If evidence shows that a measure has not typically been effective or successful, then either that measure should be modified, or the potential value of the measure to reduce effects is lowered.

2. *Practicability.* Factors considered may include cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity (16 U.S.C. 1371(a)(5)(A)(ii)).

The above section describes the factors considered in making a least practicable adverse impact finding. In summary, NMFS will carefully balance the likelihood and degree to which a measure will reduce adverse impacts on species or stocks with the measure's practicability in determining appropriate mitigation measures.

As with other rulemakings for SURTASS LFA sonar, our consideration of mitigation under the least practicable adverse impact standard was conducted at scales that take into account the entire five-year rulemaking period and broad geographic scope of potential areas of SURTASS LFA sonar activities and the types of general impacts that could occur under the rule. Based on the types of impacts that could occur, and the mitigation outlined for the activities in this proposed rule, NMFS has preliminarily determined that the least practical adverse impact standard is met. Specifically, NMFS and the Navy have considered worldwide mitigation at the scale appropriate, given the available information, and have additionally considered mitigation recommended in a white paper, entitled, ''Identifying Areas of Biological Importance to Cetaceans in Data-Poor Regions'' (White Paper), for SURTASS LFA sonar generally, and in consideration of the more specific information applicable to the current proposed operating areas for 2017–2018. The adaptive management provisions in the proposed rule allow for the consideration of new information that will potentially support the modification of mitigation and monitoring measures. This information may include new science, but also may include additional detail regarding the operational needs of the Navy described in an LOA application, which could inform a more refined least practicable adverse impact analysis, where needed.

The Navy has proposed to implement the following mitigation measures for marine mammals, most of which are included in NMFS' current regulations and LOAs for SURTASS LFA sonar:

(1) LFA sonar mitigation zone—LF source transmissions are suspended if the Navy detects marine mammals within the 180 dB received level mitigation zones by any of the following detection methods:

(a) Visual monitoring;

(b) Passive acoustic monitoring;

(c) Active acoustic monitoring.

(2) Geographic restrictions such that the received level of SURTASS LFA sonar transmissions will not exceed 180 dB in the following areas:

(a) Offshore Biologically Important Areas (OBIAs) during periods of biological importance;

(b) Coastal Standoff Zone (22 km (12 nmi) from any land).

Additionally, as with the previous rulemaking, NMFS proposes to include additional operational restrictions for SURTASS LFA sonar activities:

(1) Additional 1-km buffer around the LFA sonar mitigation zone; and

(2) Additional 1-km buffer around an OBIA perimeter.

Both the Navy's proposed mitigation and NMFS' additional proposed mitigation are discussed in the following section.

LFA Sonar Mitigation Zone

The Navy has proposed in its application to establish an LFA sonar mitigation zone corresponding to the 180-dB (RL) isopleth around the surveillance vessel (*i.e.,* LFA sonar). If a marine mammal approaches or enters the LFA sonar mitigation zone, the Navy would implement a suspension of SURTASS LFA sonar transmissions. The purpose of this mitigation zone measure in prior rules was to reduce or alleviate the likelihood that marine mammals are exposed to levels of sound that may result in injury (PTS). However, due to the revised criteria in the NMFS 2016 Acoustic Technical Guidance, this mitigation zone measure precludes not only PTS, but also almost all TTS and higher forms of behavioral harassment. Thus, while not an expansion of the mitigation zone, this measure is now considered more effective at reducing a broader range of impacts compared to prior authorizations.

Prior to commencing and during SURTASS LFA transmissions, the Navy will determine the propagation of LFA sonar signals in the ocean and the distance from the SURTASS LFA sonar source to the 180-dB isopleth (See Description of Real-Time SURTASS LFA Sonar Sound Field Modeling section). The 180-dB isopleth will define the LFA sonar mitigation zone for marine mammals around the surveillance vessel.

The Navy modeling of the sound field in near-real time conditions provides the information necessary to modify SURTASS LFA activities, including the delay or suspension of LFA transmissions. Acoustic model updates are nominally made every 12 hours, or more frequently when meteorological or oceanographic conditions change. If the sound field criteria were exceeded, the sonar operator would notify the Officer in Charge (OIC), who would order the delay or suspension of transmissions. If it were predicted that the SPLs would exceed the criteria within the next 12-hour period, the OIC would also be notified in order to take the necessary action to ensure that the sound field criteria would not be exceeded.

Description of Real-Time SURTASS LFA Sonar Sound Field Modeling

This section explains how the Navy will determine the propagation of SURTASS LFA sonar signals in the ocean and the distance from the SURTASS LFA sonar source to the 180-dB re: 1 μPa isopleth (*i.e.,* the basis for the proposed LFA sonar mitigation zone for marine mammals). NMFS provides this simplified description to aid the public's understanding of this action. However, the actual physics governing the propagation of SURTASS LFA sound signals is extremely complex and dependent on numerous in-situ environmental factors.

Prior to commencing and during SURTASS LFA sonar transmissions, the sonar operators on the vessel will measure oceanic conditions (such as sea water temperature, salinity, and water depth) in the proposed action area. This information is required for the sonar technicians to accurately determine the speed at which sound travels and to determine the path that the sound would take through the water column at a particular location (*i.e.,* the speed of sound in seawater varies directly with depth, temperature, and salinity).

The sonar operators use the near real-time environmental data and the Navy's underwater acoustic performance prediction models (updated every 12 hours or more frequently when meteorological or oceanographic conditions change) to generate a plot of sound speed versus depth, typically referred to as a sound speed profile (SSP). The SSP enables the technicians to determine the sound field by predicting the received levels of sound at various distances from the SURTASS LFA sonar source location. Modeling of the sound field in near-real time provides the information necessary to modify SURTASS LFA activities, including the delay or suspension of LFA sonar transmissions for mitigation.

NMFS' Additional 1-km Buffer Zone Around the LFA Sonar Mitigation Zone

As an added measure NMFS again proposes to require a buffer zone that extends an additional 1 km (0.62 mi; 0.54 nm) beyond the Navy's proposed 180-dB isopleth LFA sonar mitigation zone. This buffer coincides with the full detection range of the HF/M3 active sonar for mitigation monitoring (approximately 2 to 2.5 km; 1.2 to 1.5 mi; 1.1 to 1.3 nmi). Thus, the 180-dB isopleth for the LFA sonar mitigation zone, plus NMFS' 1-km (0.54 nm) buffer zone would comprise the entire shutdown mitigation zone for SURTASS LFA sonar activities, wherein suspension of transmissions would occur if a marine mammal approaches or enters either zone. Implementation of this additional 1 km buffer zone increases the shutdown zone to approximately 2 km (1.2 mile; 1.1 nmi) around the LFA sonar array and vessel and, given the highly effective monitoring capabilities (described below), will ensure that no marine mammals are exposed to an SPL greater than approximately 174 dB re: 1 μPa. In past applications, the Navy has noted that this additional mitigation is practicable and the Navy has implemented this measure in previous authorizations, so it is known that the measure is practicable. In addition, as noted above, this mitigation is more effective at reducing a broader range of impacts compared to prior authorizations, due to the revised criteria in the NMFS 2016 Acoustic Technical Guidance.

Commercial and Recreational SCUBA Diving Mitigation Zone

Navy has also proposed to establish a mitigation zone for human divers at 145 dB re: 1 μPa at 1 m around all known human commercial and recreational diving sites. Although this geographic restriction is intended to protect human divers, it will also reduce the LF sound levels received by marine mammals located in the vicinity of known dive sites.

Visual Mitigation Monitoring

The use of shipboard lookouts is a critical component of most Navy mitigation measures. Navy shipboard lookouts are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted on the water surface to the Deck Officer (*e.g.,* trash, a periscope, marine mammals, sea turtles) and all disturbances (*e.g.,* surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. There are personnel serving as lookouts on station at all times (day and night) when a Navy ship is moving through the water.

Visual monitoring consists of daytime observations for marine mammals from the bridge of SURTASS LFA sonar vessels by lookouts (personnel trained in detecting and identifying marine mammals). The objective of these observations is to maintain a bearing of marine mammals observed and to ensure that none approach close enough to enter the LFA mitigation zone or the 1-km buffer zone.

Daylight is defined as 30 min before sunrise until 30 min after sunset. Visual monitoring would begin 30 min before sunrise or 30 min before the Navy deploys the SURTASS LFA sonar array. Lookouts will continue to monitor the area until 30 min after sunset or until recovery of the SURTASS LFA sonar array.

The lookouts would maintain a topside watch and marine mammal observation log during activities that employ SURTASS LFA sonar in the active mode. These trained monitoring personnel maintain a topside watch and scan the water's surface around the vessel systematically with standard binoculars (7x) and with the naked eye. If the lookout sights a possible marine mammal, the lookout will use big-eye binoculars (25x) to confirm the sighting and potentially identify the marine mammal species. Lookouts will enter numbers and identification of marine mammals sighted into the log, as well as any unusual behavior. A designated ship's officer will monitor the conduct of the visual watches and periodically review the log entries.

If a lookout observes a marine mammal outside of the LFA mitigation or buffer zone, the lookout will notify the officer in charge (OIC). The OIC shall then notify the HF/M3 active sonar operator to determine the range and projected track of the marine mammal. If the HF/M3 sonar operator or the lookout determines that the marine mammal will pass within the LFA mitigation or buffer zones, the OIC shall order the delay or suspension of SURTASS LFA sonar transmissions when the animal enters the LFA mitigation or buffer zone to prevent Level A harassment.

If a lookout observes a marine mammal anywhere within the LFA mitigation or 1-km buffer zone (as proposed by NMFS), the lookout shall notify the OIC who will promptly order the immediate delay or suspension of SURTASS LFA sonar transmissions. The lookout will enter his/her observations into the log. The lookout will enter these observations about sighted marine mammals into the log: Date/time; vessel name; mission area; type and number of marine mammals observed; assessment basis (*i.e.,* observed injury or behavioral response); LFA mitigation or buffer zone radius; bearing from vessel; whether activities were delayed, suspended, or terminated; and relevant narrative information.

Marine mammal biologists who are qualified in conducting at-sea marine mammal visual monitoring from surface vessels shall train and qualify designated ship personnel to conduct at-sea visual monitoring. This training may be accomplished either in-person, or via video training.

Passive Acoustic Mitigation Monitoring

For the second of the three-part mitigation monitoring measures, the Navy again proposes to conduct passive acoustic monitoring using the SURTASS towed horizontal line array to listen for vocalizing marine mammals as an indicator of their presence. This system serves to augment the visual and active sonar detection systems. If a passive acoustic technician detects a vocalizing marine mammal that may be potentially affected by SURTASS LFA sonar prior to or during transmissions, the technician will notify the OIC who will immediately alert the HF/M3 active sonar operators and the lookouts. The OIC will order the delay or suspension of SURTASS LFA sonar transmissions when the animal enters the LFA mitigation or buffer zone as detected by either the HF/M3 sonar operator or the lookouts. The passive acoustic technician will record all contacts of marine mammals into a log.

Active Acoustic Mitigation Monitoring

HF active acoustic monitoring uses the HF/M3 sonar to detect, locate, and track marine mammals that could pass close enough to the SURTASS LFA sonar array to enter the LFA sonar mitigation or buffer zones. HF/M3 acoustic monitoring begins 30 min before the first SURTASS LFA sonar transmission of a given mission is scheduled to commence and continues until the Navy terminates LFA sonar transmissions.

If the HF/M3 sonar operator detects a marine mammal contact outside the LFA sonar mitigation zone or buffer zones, the HF/M3 sonar operator shall determine the range and projected track of the marine mammal. If the operator determines that the marine mammal will pass within the LFA sonar mitigation or buffer zone, he/she shall notify the OIC. The OIC then immediately orders the delay or suspension of transmissions when the animal is predicted to enter the LFA sonar mitigation or buffer zone.

If the HF/M3 sonar operator detects a marine mammal within the LFA mitigation or buffer zone, he/she shall notify the OIC who will immediately order the delay or suspension of transmissions. The HF/M3 sonar operator will record all contacts of marine mammals into the log.

Prior to full-power operations of the HF/M3 active sonar, and prior to any SURTASS LFA sonar calibrations or testing that are not part of regular SURTASS LFA sonar transmission, the Navy will ramp up the HF/M3 sonar power level over a period of 5 min from the source level of 180 dB re 1 μPa at 1 m in 10-dB increments until the system attains full power (if required) to ensure that there are no inadvertent exposures of marine mammals to received levels greater than 180 dB re 1 μPa from the HF/M3 sonar. The Navy will not increase the HF/M3 sonar source level if any of the three monitoring programs detect a marine mammal during ramp-up. Ramp-up may continue once marine mammals are no longer detected by any of the three monitoring programs.

In situations where the HF/M3 sonar system has been powered down for more than 2 min, the Navy will ramp up the HF/M3 sonar power level over a period of 5 min from the source level of 180 dB re 1 μPa at 1 m in 10-dB increments until the system attains full power.

Geographic Restrictions

As noted above, the Navy again has proposed two types of geographic restrictions for SURTASS LFA activities in their rulemaking/LOA application that entail restricting SURTASS LFA sonar activities within these designated areas such that the SURTASS LFA sonar-generated sound field will not exceed 180 dB re: 1μPa (RL): (1) Establishing OBIAs for marine mammals; and (2) observing a coastal standoff range restricting SURTASS LFA sonar activities within 22 km (13. mi; 12 nmi) of any coastline, including islands.

As with previous rulemakings for SURTASS LFA sonar, this proposed rulemaking contains a broad programmatic consideration of geographic restrictions, including OBIAs, in the world's oceans. However, as noted above, NMFS proposes to refine the process to consider additional geographic restrictions annually, as appropriate, based on any new science and the areas in which the Navy will conduct SURTASS LFA sonar activities in those years, as described in any subsequent LOA applications. The reason for this change is to allow the Navy and NMFS to focus on areas of Navy activities and known operational needs, and consideration of whether additional geographic restrictions are appropriate based on new information that may be available and taking practicability into account, at the time of the LOA application.

Offshore Biologically Important Areas

Given the unique operational characteristics of SURTASS LFA sonar, Navy and NMFS developed geographical restrictions for SURTASS LFA sonar in the SURTASS LFA Sonar FOEIS/EIS (DoN, 2001): A 12 nmi coastal standoff zone where received levels from SURTASS LFA sonar could not exceed 180 dB and designating OBIAs wherein received levels could not exceed 180 dB. These areas are intended to reduce the severity and/or scale of impacts on affected marine mammal species or stocks by avoiding or minimizing impacts in areas where marine mammals are: (1) Known to engage in specific behaviors that lead to more severe impacts if interrupted; (2) known to congregate in higher densities, and; (3) known to have a limited range and small abundance that creates more vulnerability for the stock as a whole. OBIAs were defined originally in the 2001 SURTASS LFA Sonar FOEIS/EIS (Subchapter 2.3.2.1) as those areas of the world's oceans outside of the geographic stand-off distance (greater than 22 km (12 nmi)) from a coastline (including islands) where marine animals of concern (those animals listed under the ESA and/or marine mammals) carry out biologically important activities, including migration, foraging, breeding, and calving. Limiting activities in these important areas is expected to limit the likelihood or severity of species or stock effects by minimizing the chances that take resulting from the activity will result in detrimental energetic effects (such as those that could occur in known feeding areas) or direct interference in breeding or mother/young interactions (such as those that could occur in reproductive areas) that could translate readily to reductions in reproductive success or survivorship. Three OBIAs were identified in the 2001 FOEIS/EIS: 200 m isobaths of the east coast of North America; Costa Rica Dome; and Antarctic Convergence Zone. In 2007, the Navy published a supplemental FEIS/FOEIS that designated six new OBIAs in addition to the three OBIAs that were designated in the 2001 FEIS/FOEIS.

For the 2012–2017 rule, the Deputy Assistant Secretary of the Navy for Environment (DASN(E)) determined that the purpose of NEPA and EO 12114 would be furthered by the preparation of an additional supplemental analysis related to the employment of SURTASS LFA sonar. Accordingly, the DASN(E) directed that an SEIS/SOEIS (among other things) provide further analysis of potential additional OBIAs in regions of the world where the Navy intends to use the SURTASS LFA sonar systems.

In parallel, for the 2012 rule, NMFS, with Navy input, developed a new process and screening criteria for determining an area's eligibility to be considered as an OBIA nominee for marine mammals. The new criteria consisted of: Areas with (a) High densities of marine mammals; or (b) Known/defined breeding/calving grounds, foraging grounds, migration routes; or (c) Small, distinct populations of marine mammals with limited distributions. The revised biological criteria differed from the criteria in the 2001 FOEIS/EIS (and as continued in the 2007 SEIS) in two respects. First, under the 2001 FOEIS/EIS, 2007 SEIS, and the 2007 Final Rule, an area could be designated as an OBIA only if it met a conjunctive test of being an area where: (1) Marine mammals congregate in high densities, and (2) for a biologically important purpose. Under the new criteria, any one of the biological criteria alone could be a sufficient basis for designation as an OBIA if it also met the geographic criterion of falling outside of 12 nmi (22 km) from any coastline. Second, the revised biological criteria included a new criterion of ''small, distinct population with limited distribution'' that could also, standing alone, be a basis for designation.

Notably, for the 2012 FSEIS/SOEIS and 2012 rule, NMFS also developed and implemented a robust, systematic screening process for reviewing existing and potential marine protected areas against the OBIA criteria based on the World Database on Protected Areas (WDPA, 2009), Hoyt (2005), and prior SURTASS LFA sonar OBIAs. This process produced a preliminary list of 403 OBIA nominees. As stated in the FR notice for the 2012 Final Rule (77 FR 50290), over 80 percent of the 403 existing and potential marine protected areas reviewed as potential OBIAs (340/403) were within 12 nmi from a coastline and therefore were afforded protection due to the coastal standoff zone. The remaining areas were evaluated under the OBIA criteria, and approximately 43 percent of these had sufficient information to be provided to subject matter experts (SMEs), from both within NMFS and outside of the agency, with expertise in the specific geographic regions to review for consideration of OBIAs. These SMEs provided their individual analyses of those areas and recommendations for additional OBIAs, resulting in a total of 73 potential OBIAs for consideration by the Navy and NMFS. Further analysis of the biological evidence and robustness of the data for each of these recommendations included ranking them in categories using a numbering system ranging from 0 to 4. Any of the nominees that received a ranking of 2 or higher were eligible for continued consideration as an OBIA nominee, which means that even areas requiring more data were eligible for further consideration as an OBIA. As a result of this process, 45 areas ranked high enough to be further considered as an OBIA.

Although not part of its initial screening criteria, consideration of marine mammal hearing frequency sensitivity led NMFS to screen out areas that qualified solely on the basis of their importance for mid- or high-frequency hearing specialists in past rulemaking. This was due to the LFA sound source being below the range of best hearing sensitivity for most MF and HF odontocete hearing specialists. This means, for example, for harbor porpoises, that a sound with a frequency less than 1 kHz would need to be significantly louder (more than 40 dB louder) than a sound in their area of best sensitivity (around 100 kHz) in order for them to hear it. Additionally, during the 1997 to 1998 SURTASS LFA Sonar Low Frequency Sound Scientific Research Program (LFS SRP), numerous odontocete and pinniped species (*i.e.,* MF and HF hearing specialists) were sighted in the vicinity of the sound exposure tests and showed no immediately obvious responses or changes in sighting rates as a function of source conditions, which likely produced received levels similar to those that produced minor short-term behavioral responses in the baleen whales (*i.e.,* LF hearing specialists). NMFS stated that MF and HF odontocete hearing specialists have such reduced sensitivity to the LFA source that limiting ensonification in OBIAs for those animals would not afford protection beyond that which is already incurred by implementing a shutdown when any marine mammal enters the LFA mitigation and buffer zones. Therefore, consideration of marine mammal frequency sensitivity led NMFS to screen out areas that qualified solely on the basis of their importance for MF or HF specialists.

In addition to the considerations above, NMFS reviewed Hoyt (2011), which was an update and revision of Hoyt's 2005 earlier work, along with areas recommended in public comments received on the 2012 DSEIS/SOEIS. As a result of this further analysis, NMFS concluded that there was adequate basis to designate 22 OBIAs for the Navy to consider for practicability. The OBIAs in the 2012 FSEIS/SOEIS and NMFS' proposed rule were: Georges Bank (year round); Roseway Basin Right Whale Conservation Area (Canadian restriction June through December annually); Great South Channel, US Gulf of Maine, and Stellwagen Bank NMS (January 1 to November 14 annually); Southeastern US Right Whale Seasonal Habitat (November 15 to April 15 annually); North Pacific Right Whale Critical Habitat (March through August annually); Silver Bank and Navidad Bank (December through April); Coastal Waters of Gabon, Congo and Equatorial Guinea (June through October annually); Patagonia and Shelf Break (year round); Southern Right Whale Seasonal Habitat (May through December annually); Central California NMS (June through November); Antarctic Convergence Zone (October through March annually); Piltun and Chayvo Offshore Feeding Grounds—Sea of Okhotsk (June through November annually); Coastal Waters off Madagascar (July through September and November through December annually); Madagascar Plateau, Madagascar Ridge, and Walters Sound (November through December annually); Ligurian-Corsican-Provencal Basin and Western Pelagos Sanctuary (July to August annually); Hawaiian Islands Humpback Whale NMS—Penguin Bank (November through April annually); Costa Rica Dome (year round); Great Barrier Reef Between (May through September annually); Bonney Upwelling (December through May annually); Northern Bay of Bengal and Head of Swatch-of-No-Ground (year round); Olympic Coast: The Prairie, Barkley Canyon, and Nitnat Canyon (December, January, March and May and June to September); and an area within the Southern California Bight (specifically including Tanner and Cortez Banks—June through November, annually). The Southern California Bight area was the only OBIA candidate that was operationally impracticable for the Navy. Therefore, 21 OBIAs were considered candidates in the 2012 Proposed Rule. For the Final Rule, NMFS designated one additional OBIA (Abrolhos Bank, August through November annually), resulting in 22 designated OBIAs for SURTASS LFA sonar.

In response to public comments on the 2012 proposed rule, NMFS also reevaluated its preliminary decision not to include areas that meet the criteria for sperm whales and pinnipeds, and ultimately determined such areas would be appropriate for OBIA designation where information established the criteria were met, and in fact noted that OBIA 8 (Patagonia Shelf) had already been identified for elephant seals. While no OBIAs had been identified for sperm whales, NMFS committed to considering sperm whales in future analyses should supporting information become available.

From 2012 to the present, the Navy and NMFS have maintained a list of potential marine areas for which information or data have not been sufficient to designate as OBIAs, and reviewed new literature to determine if additional areas should be added to the list of potential areas. Potential areas are periodically evaluated or re-assessed to determine if information and data are available to provide adequate support under one of the OBIA biological criteria. NMFS refers the reader to the Navy's 2016 SDEIS/SOEIS, subsection 4.2.2.2.5 and Appendix C for more detail on the analysis for potential OBIAs as part of this 2017 action. As part of the ongoing Adaptive Management component of the 2012 final rule, and in preparation for the DSEIS/SOEIS, NMFS and Navy reviewed potential OBIAs. This process included conducting a comprehensive assessment of newly available peer-reviewed scientific data, information, or survey data on marine areas that met the geographic eligibility requirements for consideration as OBIAs and reviewing the updated WDPA (2016); 2014 United Nations List of Protected Areas (Deguignet *et al.,* 2014), the Convention on Biological Diversity; MPA Global (Wood, 2007), the Marine Conservation Institute MPAtlas (2015); and cetaceanhabitat.org (see the Navy's DSEIS/OEIS, subsection 4.2.2.2.5 for a more detailed description of the analyses provided here).

Based on this extensive review (including examination of new data for areas that previously did not meet the OBIA criteria), a preliminary list of eight new candidate OBIAs and the expansion of four existing OBIAs were developed and presented to SMEs for review. During the SME review, it was suggested that another existing OBIA be considered for expansion, bringing the total number of existing OBIAs to be considered for expansion to five.

After additional evaluation, NMFS and Navy agreed that two of the new areas on the preliminary candidate list did not meet the criteria for designation as an OBIA. One of these (Southern Australia Southern Right Whale Calving Area) was determined to be solely within the coastal exclusion zone. The other (Tanner and Cortez Banks, which was included in an area considered in the original list of 22 OBIAs) was considered as possibly meeting the foraging biological criterion based on Calambokidis *et al.* (2015), which stated that this area represented a feeding area based on 52 sightings of blue whales in the region. However, most of these sightings occurred over 10 years ago, and the analysis did not consider data from satellite-tagged individuals. Irvine *et al.* (2014) used data from 171 blue whales tagged between 1993 and 2008 to define core areas where blue whales are most likely to occur. Tanner and Cortez Banks were within the distributional range of blue whales, but residence time within the banks was not significant. Ongoing studies of blue whale habitat (Mate *et al.,* 2015 and 2016) may or may not provide further insight into areas off the U.S. west coast that may meet the criteria for designation as OBIAs. Therefore, NMFS and Navy will continue to evaluate Tanner and Cortez Banks as a possible OBIA (subject to operational practicability) as new data become available.

In summary, NMFS and Navy agreed to a total of six new proposed OBIAs and the proposed expansion of five existing OBIAs. These were presented to Navy for a practicability review. The Navy determined that there were no practicability issues related to the use of SURTASS LFA sonar that would affect the implementation of these OBIAs, and in fact agreed to observe restrictions in each of these areas near requested mission areas as part of their 2016–2017 LOAs under the 2012 rule while public review of these areas is underway as part of the NEPA process (DSEIS/SOEIS) and rulemaking for the 2017–2022 period. While none of these new OBIAs were identified specifically for sperm whales, OBIA #28 (Perth Canyon) is designated for blue and pygmy blue whales with added protection for sperm whales. An area, the Hellenic Trench area in the Mediterranean Sea, was considered solely for sperm whales, but the core usage area was wholly within the coastal standoff range, so the area did not qualify as an OBIA based on the geographical criteria (while receiving similar treatment due to the fact that it was within the coastal standoff range).

A comprehensive list of the resulting 28 proposed OBIAs for SURTASS LFA sonar, as presented in the Navy's SDEIS/SOEIS, is provided in Table 31 below (see Navy's DSEIS/SOEIS, sections 3.3.5.3 and 4.2.2.2.5, and Appendix C for more detail on OBIAs).

TABLE 31—COMPREHENSIVE LIST OF MARINE MAMMAL OBIAS PROPOSED FOR SURTASS LFA SONAR

OBIA No.	OBIA name	Location	Species	Seasonal period	OBIA boundary change [1]	Notes
1	George's Bank	Northwest Atlantic Ocean	North Atlantic Right Whale.	Year-round	R	
2	Roseway Basin Right Whale Conservation Area.	Northwest Atlantic Ocean	North Atlantic Right Whale.	June through December, annually.		
3	Great South Channel, Gulf of Maine, and Stellwagen Bank NMS.	NW Atlantic Ocean/Gulf of Maine.	North Atlantic Right Whale.	January 1–November 14, annually.	E–CH	OBIA 3 boundary revised to encompass expansion of northeastern U.S. critical habitat for the North Atlantic right whale (Potential OBIA 2).
4	Southern U.S. Right Whale Critical Habitat.	NW Atlantic Ocean	North Atlantic Right Whale.	November 15–April 15, annually.	E–CH	OBIA 4 boundary revised to encompass expansion of southeastern U.S. critical habitat for the North Atlantic right whale (Potential OBIA 3).

TABLE 31—COMPREHENSIVE LIST OF MARINE MAMMAL OBIAS PROPOSED FOR SURTASS LFA SONAR—Continued

OBIA No.	OBIA name	Location	Species	Seasonal period	OBIA boundary change [1]	Notes
5	Gulf of Alaska [2]	Gulf of Alaska	North Pacific Right Whale	March through August, annually.	E, R	OBIA 5 boundary revised to encompass additional foraging area for the North Pacific right whale (Potential OBIA 11).
6	Navidad Bank [3]	Caribbean Sea/NW Atlantic Ocean.	Humpback Whale	December through April, annually.	R	Silver Bank no longer encompassed within OBIA boundary.
7	Coastal Waters of Gabon, Congo, and Equatorial Guinea.	SE Atlantic Ocean	Humpback and Blue Whale.	June through October, annually.	R	
8	Patagonian Shelf Break	SW Atlantic Ocean	Southern Elephant Seal	Year-round.		
9	Southern Right Whale Seasonal Habitat.	SW Atlantic Ocean	Southern Right Whale	May through December, annually.	R	
10	Central California [4]	NE Pacific Ocean	Blue and Humpback Whales.	June through November, annually.	E, R	OBIA 10 boundary revised to encompass additional foraging area for the blue and humpback whales (Potential OBIA 5).
11	Antarctic Convergence Zone.	Southern Ocean	Blue, Fin, Sei, Minke, Humpback Whales, and Southern right whale.	October through March, annually.	R	
12	Pilton and Chayvo Offshore Feeding Grounds.	Sea of Okhotsk	Western Pacific gray whale.	June through November, annually.	R	
13	Coastal Waters off Madagascar.	Western Indian Ocean	Humpback whale and Blue whale.	July through September, annually for humpback whale breeding; November through December for migrating blue whales.	R	
14	Madagascar Plateau, Madagascar Ridge, and Walters Shoal.	Western Indian Ocean	Pygmy blue whale, Humpback whale, and Bryde's whale.	November through December, annually.		
15	Ligurian-Corsican-Orovencal Basin and Western Pelagos Sanctuary.	Northern Mediterranean Sea.	Fin Whale	July to August, annually	R	
16	Penguin Bank, Hawaiian Islands Humpback Whale National Marine Sanctuary.	North-Central Pacific Ocean.	Humpback Whale	November through April, annually.	R	
17	Costa Rica Dome	Eastern Tropical Pacific Ocean.	Blue whale and Humpback whale.	Year-round.		
18	Great Barrier Reef Between.	Coral Sea/SW Pacific Ocean.	Humpback whale and Dwarf minke whale.	May through September, annually.	E, R	OBIA 18 boundary revised to encompass additional breeding/calving area for the humpback whale (Potential OBIA 8).
19	Bonney Upwelling	Southern Ocean	Blue whale, Pygmy blue whale, and Southern right whale.	December through May, annually.	R	
20	Northern Bay of Bengal and Head of Swatch-of-No-Ground (SoNG).	Bay of Bengal/N Indian Ocean.	Bryde's whale	Year-round	R	
21	Olympic Coast National Marine Sanctuary and the Prairie, Barkley Canyon, and Nitnat Canyon.	NE Pacific Ocean	Humpback whale	Olympic National Marine Sanctuary: December, January, March, and May, annually; The Prairie, Barkley Canyon, and Nitnat Canyon: June through September, annually.		
22	Abrolhos Bank	Southwest Atlantic Ocean	Humpback whale	August through November, annually.		
23	Grand Manan North Atlantic Right Whale Critical Habitat.	Bay of Fundy (Canada)	North Atlantic right whale	June through December, annually.		Potential OBIA 1; Canadian critical habitat for the North Atlantic right whale.
24	Eastern Gulf of Mexico	Eastern Gulf of Mexico	Bryde's whale	Year-round		Potential OBIA 4.
25	Southern Chile Coastal Waters.	Gulf of Corcovado, southeast Pacific Ocean (SW Chile).	Blue whale	February to April, annually.		Potential OBIA 6.
26	Offshore Sri Lanka	North-Central Indian Ocean.	Blue whale	December through April, annually.		Potential OBIA 7.
27	Camden Sound/Kimberly Region.	Southeast Indian Ocean (NW Australia).	Humpback whale	June through September, annually.		Potential OBIA 9.

TABLE 31—COMPREHENSIVE LIST OF MARINE MAMMAL OBIAS PROPOSED FOR SURTASS LFA SONAR—Continued

OBIA No.	OBIA name	Location	Species	Seasonal period	OBIA boundary change [1]	Notes
28	Perth Canyon	Southeast Indian Ocean (SW Australia).	Pygmy blue whale/Blue whale.	January through May, annually.		Potential OBIA 10.

[1] E = Expanded per data justification; E–CH = Expanded to encompass designated critical habitat; R = landward boundary revised per higher resolution 12-nmi data.

[2] Name changed to indicate expansion of OBIA beyond extent of North Pacific right whale critical habitat.

[3] Name changed to indicate that Silver Bank is no longer encompassed within OBIA boundary (instead, is encompassed in and afforded protection under the coastal standoff range for SURTASS LFA Sonar).

[4] Name changed to indicate that expanded OBIA boundary is not coterminous with sanctuaries' boundaries.

NMFS' Additional 1-km Buffer Zone Around an OBIA Perimeter

NMFS also proposes an OBIA ''buffer'' requirement that would restrict the operation of SURTASS LFA sonar so that the SURTASS LFA sonar sound field does not exceed 180 dB re: 1 μPa at a distance of 1 km (0.62 mi; 0.54 nmi) seaward of the outer perimeter of any OBIA designated for marine mammals during the specified period. The Navy has noted in previous authorizations that this measure is practicable and it would adhere to this additional measure, so there would effectively be a 174-dB exclusion zone around any OBIA perimeter with implementation of this buffer.

OBIAs are mitigation measures for SURTASS LFA sonar and are based on the system's unique operating and physical characteristics and should not be assumed to be appropriate for other activities.

Critical Habitat

Under Section 7 of the ESA, all Federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or destroy or adversely modify its designated critical habitat. Critical habitat is not designated in foreign countries or any other areas outside of U.S. jurisdiction. Critical habitat within the U.S. Exclusive Economic Zone (EEZ) has been designated for six of the 22 of the ESA-listed marine mammal species. Of the designated critical habitat for marine mammals, four areas of critical habitat are located at a distance sufficient from shore to potentially be affected by SURTASS LFA sonar: Critical habitat for the north Atlantic right whale (NARW), north Pacific right whale (NPRW), Hawaiian monk seal, and Steller sea lion. The Navy proposes that the sound field would not exceed 180 dB re: 1 μPa in the areas designated as critical habitat for the NARW and NPRW.

In 2016, critical habitat for the NARW was expanded to include a total of 29,763 nmi^2 (102,084 km^2) of habitat in the Gulf of Maine and Georges Bank area as well as off the southeast U.S. Atlantic coast. The southern critical habitat area was expanded by 341 nmi (1,170 km^2) and includes nearshore and offshore waters from Cape Fear, NC south to approximately 27 nmi (50 km) south of Cape Canaveral, FL (NOAA, 2016). OBIAs that encompass the critical habitat for the NARW were established in previous rulemakings and expansion of these OBIAs to encompass the expanded critical habitat has been proposed in the Navy's 2016 SDEIS/SOEIS and rulemaking/LOA application. These existing/proposed OBIAs encompass the critical habitats located beyond the coastal standoff range, including the recent critical habitat expansions, of the NARW on Georges Bank (OBIA #1); Roseway Basin Right Whale Conservation Area (OBIA #2); portions of the Great South Channel, Gulf of Maine, and Stellwagen Bank National Marine Sanctuary that are located outside of 22 km (13. mi; 12 nmi) (OBIA #3 Grand Manan NARW critical habitat in the Bay of Fundy (OBIA 23); and the southeastern U.S. NARW seasonal critical habitat (OBIA #4).

In 2008, NMFS designated two areas of critical habitat for the NPRW. One of these locations is in the Bering Sea, where the Navy will not conduct SURTASS LFA sonar activities, and the other is in the Gulf of Alaska. For the designated critical habitat area in the Gulf of Alaska, the Navy designated an OBIA (#5) in previous rulemaking that bounds the designated critical habitat for the species. This OBIA is additionally proposed for expansion in the Navy's 2016 DSEIS/SOEIS to include waters beyond the critical habitat boundary where more recent sightings have been documented for this species.

Much of the proposed critical habitat for Hawaiian monk seals is located within the coastal standoff range for SURTASS LFA sonar (22 km (13. mi; 12 nmi) of any land) and no existing or proposed OBIA encompasses the entirety of Hawaiian monk seal critical habitat. However, OBIA (#16) encompasses the Penguin Bank portion of the Hawaiian Islands Humpback Whale National Marine Sanctuary. The portion of the Hawaiian monk seal critical habitat that may occur beyond the coastal standoff range for SURTASS LFA sonar is the lowest portion of the water column, including the waters 33 ft (10 m) above the seafloor and the seafloor, seaward from certain areas of the Hawaiian Island's shoreline to the 656-ft (200 m) isobath.

Much of the critical habitat for the Steller sea lion is located in the Bering Sea, where SURTASS LFA sonar will not operate. No proposed OBIA encompasses the Gulf of Alaska critical habitat for Steller sea lions. Although it is possible that SURTASS LFA sonar will be operated in the western Gulf of Alaska where the eastern critical habitat for the Steller sea lion is located and some of that habitat lies beyond 22 km (13. mi; 12 nmi) from shore (*i.e.,* the coastal standoff range for SURTASS LFA sonar), the water depth in which the habitat is found is sufficiently shallow that it is unlikely that the Navy would operate SURTASS LFA sonar in the vicinity.

Both the Navy and NMFS Protected Resources Permits and Conservation Division are consulting with NMFS Protected Resources Interagency Cooperation Division on effects on critical habitat pursuant to section 7 of the ESA.

Coastal Standoff Zone

The Navy has proposed to restrict SURTASS LFA sonar activities within 22 km (13. mi; 12 nmi) of any coastline, including islands, such that the SURTASS LFA sonar-generated sound field will not exceed 180 dB re: 1 μPa (RL) at that seaward distance. This measure is intended to minimize both the severity and scale of effects to marine mammals by avoiding the higher densities of many species that may be found in coastal areas and it is practicable. Additionally, this restriction limits exposures of marine mammals to high-level sounds in the vicinity of geographical features that have been associated with some stranding events, *i.e.,* enclosed bays, narrow channels, etc.

Operational Exception

It may be necessary for SURTASS LFA sonar transmissions to be at or above 180 dB re 1 µPa (rms) within the boundaries of a designated OBIA when: (1) Operationally necessary to continue tracking an existing underwater contact; or (2) operationally necessary to detect a new underwater contact within the OBIA. This exception will not apply to routine training and testing with the SURTASS LFA sonar systems.

White Paper on ''Identifying Areas of Biological Importance to Cetaceans in Data-Poor Regions''

As discussed above, NMFS convened a panel of SMEs to help identify marine mammal OBIAs relevant to the Navy's use of SURTASS LFA sonar. Separately, we asked a NMFS scientist, who was also on that same panel, to help address a recommendation that NMFS consider a global habitat model (Kaschner *et al.,* 2006) in the development of OBIAs. In addition to providing the requested input (which essentially concluded that using the Kaschner model was not advisable for several reasons), this NMFS scientist consulted with other NMFS scientists to provide some additional guidance in alternate methods for considering data poor areas and drafted a white paper entitled, ''Identifying Areas of Biological Importance to Cetaceans in Data-Poor Regions'' (White Paper).

In the White Paper, the authors acknowledge that ''[m]anagement decisions that NMFS must make often incorporate species-specific information on cetacean distribution, population density, abundance, or ecology to identify regions of biological importance. When relevant cetacean data are lacking for the appropriate region or spatial scale, it is not acceptable to proceed in the decision making process as if the 'no data' scenario were equivalent to 'zero population density' or 'no biological importance.' '' The authors recognize this is not an assumption that NMFS makes in regard to identification of OBIAs by stating ''[t]his is acknowledged in the screening criteria for identification of OBIA Nominees, which state, 'For locations/regions and species and stocks for which density information is limited or not available, high density areas should be defined (if appropriate) using some combination of the following: Available data, regional expertise, and/or habitat suitability models utilizing static and/or predictable dynamic oceanographic features and other factors that have been shown to be associated with high marine mammal densities.' '' We additionally note here that the absence of an OBIA does not mean that NMFS assumes no marine mammal presence or biological importance. Even where there are no OBIAs, NMFS continues to impose mitigation measures (*i.e.,* shut down measures with highly effective monitoring and coastal standoff zones) because NMFS recognizes that marine mammals could be present. The White Paper authors acknowledge that for much of the world's oceans, data on cetacean distribution or density do not exist, and suggest that ''[w]hen providing management advice for such data-poor areas, it is prudent to ask whether an analytical model should be used to infer patterns of distribution or density, or if a broader approach that incorporates expert opinion from multiple sources of information would be more reliable and more practical.''

The White Paper authors considered examples of an approach relying on minimal information (analogous to a data-poor scenario) and provided Kaschner *et al.* (2006) as an example of such an approach. In this example, Kaschner *et al.* used models based on a synthesis of ''existing and often general qualitative observations about the spatial and temporal relationships between basic environmental conditions and a given species' presence'' to ''develop a generic quantitative approach to predict the average annual geographic ranges'' of marine mammal species on a global scale. Several environmental correlates including depth, sea surface temperature, distance to land, and mean annual distance to ice edge were used in the Kaschner effort. After evaluating four case studies from the Kaschner *et al.* (2006) study for predicting gray whale, northern right whale dolphin, North Atlantic right whale, and narwhal distribution, the authors of the White Paper concluded that '[t]he predictions from the four case studies . . . included errors of omission (exclusion of areas of known habitat) and commission (inclusion of areas that are not known to be habitat) that could have important implications if the model predictions alone were used for decision making in a conservation or management context.'' Specifically, the White Paper illustrated that the Kaschner *et al.* effort omitted a considerable portion of known gray whale habitat; overestimated the range of suitable habitat for northern right whale dolphins off the U.S. West Coast (noting that species-specific models based on dedicated shipboard surveys more correctly identified suitable habitat); predicted habitat for North Atlantic right whales in large areas where they have never been recorded; and predicted suitable habitat for narwhal that did not correspond with their known distribution. Noting these errors, the White Paper authors further make a distinction between a species ''fundamental niche'' (which is purportedly predicted by Kashner *et al.'s* [2006] models) and a species ''realized niche'' (a species' observed distribution), ''which is a modification of the fundamental niche due to interspecific and intraspecific dynamics, interactions with the physical environment, and historical events'', and ''is typically relevant in the conservation and management context.'' In short, the White Paper illustrates that such predictive models in data-poor situations may not be the most appropriate methodology in the conservation and management decision making context due to potential errors of omission and commission and the differences between ''fundamental niches'' predicted by such models and a species' ''realized niche.'' NMFS concurred with this recommendation and elected not to use the Kaschner paper as a basis for identifying additional protective areas.

For data-poor scenarios, the White Paper recommends considering general guidelines based on ecological principles to identify areas of biological importance and potential restriction for cetaceans. However, the authors conclude the White Paper by stating that ''. . . the question of whether the decision-making process and management actions should be precautionary will affect the type of guidelines that should be used to make inferences about cetacean density and biological importance in data-poor regions.''

In *NRDC* v. *Pritzker,* referring to the White Paper, the Ninth Circuit stated that NMFS, in its 2012 rule, ''did not give adequate protection to areas of the world's oceans flagged by its own experts as biologically important, based on the present lack of data sufficient to meet the Fisheries Service's [OBIA] designation criteria, even though NMFS' own experts acknowledged that [f]or much of the world's oceans, data on cetacean distribution or density do not exist.'' NRDC v. Pritzker, 828 F.3d 1125 at 1142.

In the 2012 rule, NMFS evaluated the White Paper through the lens of the OBIA process, which may have limited fuller consideration of the recommendation. Here, for this 2017 rulemaking, NMFS explains how it examines the White Paper's recommendations in the context of the least practicable adverse impact standard. The White Paper recommended the following general guidelines based on ecological principles to identify areas of biological importance for cetaceans:

(1) Designation of all continental shelf waters and waters 100 km seaward of the continental slope as biologically important habitat for marine mammals;

(2) Establishment of OBIAs within 100 km of all islands and seamounts that rise within 500 m of the surface; and

(3) Nomination of high productivity regions that are not included in the continental shelf, continental slope, seamount, and island ecosystems above as biologically important areas.

These recommendations are evaluated below in the context of the proposed SURTASS LFA sonar activities and the other mitigation measures that are proposed to minimize the impacts on the affected marine mammal species or stocks from these activities. To reiterate, NMFS is proposing several mitigation measures for SURTASS LFA sonar activities that: (1) Minimize or alleviate the likelihood of injury, TTS, or more severe behavioral responses (the 180-dB LFA mitigation zone plus 1-km buffer zone shutdown measure); (2) minimize or avoid behavioral impacts in known important areas that would have a higher potential to have negative energetic effects or deleterious effects on reproduction that could reduce the likelihood of survival or reproductive success (OBIAs); and (3) generally lessen the total number of takes of many species with coastal or shelf habitat preferences (coastal standoff). The nature and context of how LFA sonar is used in these activities (only 4 ships operating in open oceans areas and typically using active sonar only sporadically) is such that impacts to any individual are expected to be limited primarily because of the short duration of exposure to any individual mammal. In addition, as explained above, an animal would need to be fairly close to the source for the entire length of a transmission to experience injury; exposures occur in open water areas in which animals can more readily avoid the source or find alternate habitat relatively easily; and highly effective mitigation measures have been adopted that further ensure impacts are limited to lower-level effects with limited potential to significantly alter natural behavior patterns in ways that would affect the fitness of individuals.

SURTASS LFA operates at 100 to 500 Hz. This frequency is far below the best hearing sensitivity for MF and HF species. HF species have their best hearing between 60 and 125 kHz (best around 100 kHz), which means that a sound at 500 Hz (and below) has to be at least 50 dB louder for HF species to hear it as well as a sound in their best hearing range. MF cetaceans have their best hearing between 40 and 80 kHz (best around 55 kHz), which means that at 500 Hz and below, the sound has to be 40 dB louder, or more, for this group to hear the sound as well as a sound in their best hearing range. This means that these species have to be much closer to a sound to hear it, which means that, generally, they have to be much closer to the SURTASS sonar source for it to cause PTS, TTS, or a behavioral response. Additionally, during the 1997 to 1998 SURTASS LFA Sonar Low Frequency Sound Scientific Research Program (LFS SRP), numerous odontocete species (*i.e.,* MF and HF hearing specialists) and pinniped species were sighted in the vicinity of the sound exposure tests and showed no immediately obvious responses or changes in sighting rates as a function of source conditions, which likely produced received levels similar to those that produced minor short-term behavioral responses in the baleen whales (*i.e.,* LF hearing specialists).

As described in the 2012 rule, NMFS believes that MF and HF odontocete hearing specialists have such reduced sensitivity to the LFA sonar source that limiting ensonification in OBIAs for those animals would not afford meaningful protection beyond that which is already incurred by implementing a shutdown when any marine mammal enters the LFA mitigation and buffer zones. For the same reason, our discussion of the White Paper recommendations will be limited to lower frequency sensitive species, although it is worth noting that the existing 22 km coastal standoff ensures a reduced number of potential takes of many MF and HF species with coastal habitat preferences.

As noted previously, in evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, we carefully balance the expected benefits of the mitigation measures against the practicability of implementation. This balancing considers the following factors: (1) The manner in which, and the degree to which, the implementation of the measure(s) is expected to reduce impacts to marine mammal species or stocks, their habitat, and their availability for subsistence uses (where relevant). Among other things, this analysis will consider the nature of the proposed adverse impact (likelihood, scope, range), the likelihood that the measure will be effective if implemented, and the likelihood of successful implementation; (2) the practicability of the measures for applicant implementation. Practicability of implementation may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity (16 U.S.C. 1371(a)(5)(A)(ii)).

In addition to the considerations discussed above, NMFS' evaluation of the recommendations of the White Paper is described below:

Continental Shelf Waters and Waters 100 km Seaward of Continental Slope

Reduction of Adverse Impacts to Marine Mammal Species and Stocks and Their Habitat

The Navy already implements a coastal standoff zone of 22 km, which includes large parts of the continental shelf around the world, includes parts of the slope in some areas, and reduces potential takes of many marine mammal species and stocks with coastal habitat preferences. The White Paper provided little basis for the 100 km buffer seaward of the continental slope and we have found no specific literature to support such a broad buffer in all areas. Therefore, in the context of this evaluation, NMFS first considered if there was evidence of the importance of the continental slope itself, without any consideration for a buffer. In support of understanding the additional value of expanding this standoff to 100 km beyond the continental slope margin, NMFS assessed known marine mammal density information for lower frequency hearing specialists from the U.S. East (Roberts *et al.,* 2016) and West coasts and compared these densities to bathymetry, specifically looking at areas of high densities compared to the continental shelf and slopes on both coasts (NOAA, 2009). This assessment and comparison focused on the U.S. East and West coasts as an example due to the fact that relatively more data is available for these waters. The comparison showed that mapped areas of highest densities are not always related to the slope or shelf. For example, while fin whales in the eastern U.S. waters show higher densities on the continental shelf and slope, higher densities of fin whales in western U.S. waters are much farther out to sea from the continental shelf or slope (well beyond 100 km beyond the slope), and the same was found for sperm whales. Some mysticetes do show higher densities on the continental shelf, and some have higher densities along the continental slope, which may also vary among seasons (*e.g.,* fin whales on the east coast). Generally, density information from the Atlantic showed some enhanced densities along the slope, but only for certain species in certain seasons, and did not indicate universally high densities along the slope. Humpback whales (especially around Cape Hatteras) seem to show some higher densities around the slope, but also seaward of the slope, especially in winters. However, the shelf slope is closer to the shore around Cape Hatteras than most places along the eastern seaboard, and while humpbacks may show higher densities along the slope in this area, the same cannot be said of humpbacks further south (*i.e.,* in Florida) where the slope is much further offshore. Right whales show higher densities closer to shore along the Atlantic coast, while sperm whales are farther out past the slope on the Atlantic coast, as they are deep divers. Density data from the Pacific coast show higher densities of blue whales on the shelf and slope, while fin whales and sperm whales are observed in waters beyond the continental slope. Gray whales show higher densities closer to shore along the Pacific coast, while humpbacks seem to be along the slope and beyond in some places. Using the continental United States densities of these lower frequency sensitive species as examples showed that densities are sometimes higher within 100 km of the slope, but are often higher elsewhere (off the slope) and many of these high density areas are highly seasonal. Therefore, restricting activities within 100 km of the entire continental shelf and slope is of limited value year-round.

We have emphasized in the OBIA context that although we are identifying ''known'' biologically important areas, other biologically important areas have yet to be identified, especially for data-poor areas. However, it is important to note that much more research is conducted close to shore, in the United States and other areas, and typically areas within 100 km of the slope are much less likely to be data-poor areas. NOAA, Navy, other agencies, and many independent researchers have been conducting marine mammal research throughout the U.S. EEZ (200 miles from shore) for decades. While higher densities of LF species may be found in some shelf and slope areas close to shore, which may indicate some important habitat features are present for some of these species, these higher densities are not associated with important behaviors in the same way OBIAs represent areas that are biologically important to a species or stock. Moreover, the prevalence of research makes it much less likely that important areas closer to shore have been missed.

NMFS acknowledges that large ocean areas such as the continental shelf and slope and seamounts may exhibit habitat features that provide important habitat for marine mammals at certain times—as the White Paper states, the higher productivity in these areas could generally be associated with higher densities of marine mammals. However, due to the fact that other mitigation measures would already limit most take of marine mammals to lower Level B behavioral harassment, there is little to no indication that there is a risk to marine mammal species or stocks that would be avoided or lessened if waters 100 km seaward of the continental slope were subject to restrictions. Of note, of the 22 OBIAs in the 2012 proposed rule, 17 of these included continental shelf/slope areas and similar coastal waters. In addition, these waters of the continental shelf/slope would be afforded significant protection due to the coastal standoff mitigation measure.

Given the mitigation measures already in place, and proposed for this rule, that would limit most takes of marine mammals to lower Level B behavioral harassment, the only additional benefit to restricting activities in continental shelf waters and waters 100 km seaward of continental slope would be a further, though not significant, reduction in these lower level behavioral takes in those areas. As discussed above, not all behavioral responses may result in take and not all behavioral takes necessarily result in fitness consequences to individuals that have the potential to translate to population consequences to the species or stock. For example, energetic costs of short-term intermittent exposures would be unlikely to affect individuals such that vital rates of the population are affected.

In addition to the mitigation measures in place, and proposed again, for SURTASS LFA sonar use that would already provide protection for continental shelf/slope waters, it is important to note that there are a total of four SURTASS LFA sonar ships that would each be operating up to a maximum of 255 transmission hours per year (amounting to approximately 40 days maximum of LFA, which is spread over the entire year). It is not known, nor does the Navy indicate in its plans, that activities of these four vessels would be focused in any specified area. It is likely, based on past monitoring reports, that the activities of these four vessels are spread out and would not necessarily overlap marine mammal high-density areas for an extended period of time. Although some LFA sonar activities could, on occasion, overlap marine mammal high-density areas, the Navy is still bound by the 12% cap on Level B takes per marine mammal stock annually. However, because areas of marine mammal high density are dispersed over large ocean areas for each species, it is certain that LFA sonar would not implicate all of these areas for a given species or stock in any year. Given the expanse of these areas (*e.g.,* entire eastern and western coast of the U.S. for continental shelf/slope), even if part of the area would be exposed to LFA sonar, there would still be ample similar habitat areas available for species/stocks if it were preferred habitat.

Practicability

NMFS and the Navy evaluated the practicability of implementation of the White Paper's recommended continental shelf, slope, and 100-km seaward The Navy has indicated, and NMFS concurs, that additional continental shelf, slope, and 100 km seaward restrictions beyond the existing coastal standoff and OBIAs would unacceptably impact the Navy's national security mission as large areas of the ocean would be restricted where targets of interest may operate. The mission of SURTASS LFA sonar is to detect quieter and harder to-find foreign submarines at greater distances. For the system to perform its national defense function, the Navy must operate within coastal, littoral waters in order to track relevant targets. The Navy has indicated that if large areas of the continental shelf or slope were restricted, the Navy would not have the benefit of being able to train and operate in these challenging environments, while adversaries would use these distinctive geographic features to their advantage. Year-round access to all of these areas of challenging topography and bathymetry is necessary as the Navy cannot telegraph to potential adversaries that it will not be operating in large parts of the ocean for long periods of time.

Conclusion

In summary, while restricting SURTASS LFA sonar use in waters 100 km seaward from the continental slope could potentially reduce individual exposures or behavioral responses for certain species and potentially provide some additional protection of preferred habitat in some cases, density data indicates that certain mysticetes and sperm whales have higher densities in areas other than the continental slope. Therefore, limiting activities in these large areas when activities are comparatively low (no more than four ships each operating up to a maximum of 255 transmission hours spread across expansive distances and over the course of an entire year), and the existing risks to the affected species and stocks are low, would provide limited discernible benefit. This is especially true given that many mysticete species have latitudinal seasonal movements that would render these large areas of less, or no, importance to these species in certain portions of the year. Given the limited potential for additional reduction of impacts to marine mammal species beyond what the existing mitigation measures described in this proposed rule provide, and the high degree of impracticability (significant impacts on mission effectiveness), NMFS has preliminarily determined that this measure is not required.

Restrictions Within 100 km of All Islands and Seamounts That Rise to Within 500 m of the Surface

Reduction of Adverse Impacts to Marine Mammal Species and Stocks and Their Habitat

Currently, waters surrounding all islands are already protected by the coastal standoff zone (22km). As discussed previously, this means that SURTASS LFA sonar received levels would not exceed 180 dB re 1μPa within 22 km (12 nmi) from the coastline. This 22 km coastal standoff was determined in previous analyses (DoN, 2007) to result in the lowest potential risk to marine species, particularly marine mammals. Morato *et al.* (2010) state that seamounts were found to have higher species diversity within 30–40 km of the summit, and tended to aggregate some visitor species (Morato *et al.,* 2008). However, the authors did not demonstrate that this behavior can be generalized to be universally applicable to all species at all times.

Morato *et al.* (2008) examined seamounts for their effect on aggregating visitors and noted that seamounts may act as feeding stations for some visitors, but not all seamounts seem to be equally important for these associations. While Morato *et al.* (2008) only examined seamounts in the Azores, the authors noted that only seamounts shallower than 400 m depth showed significant aggregation effects. Their results indicated that some marine predators (common dolphin (*Delphinus delphis*) and other non-marine mammal species such as fish and invertebrates) were significantly more abundant in the vicinity of some shallow-water seamount summits, there was no demonstrated seamount association for bottlenose dolphins (*Tursiops truncatus*), spotted dolphin (*Stenella frontalis*), or sperm whales (*Physeter macrocephalus*).

Along the northeastern U.S. continental shelf, cetaceans tend to frequent regions based on food preferences (*i.e.,* areas where preferred prey aggregate), with picscivores (fish-eating; *e.g.,* humpback, fin, and minke whales as well as bottlenose, Atlantic white-sided, and common dolphins) being most abundant over shallow banks in the western Gulf of Maine and mid-shelf east of Chesapeake Bay; planktivores (plankton-eating; *e.g.,* right, blue, and sei whales) being most abundant in the western Gulf of Maine and over the western and southern portions of Georges Bank; and teuthivores (squid eaters, *e.g.,* sperm whales) most abundant at the shelf edge (Fiedler, 2002). While there have been observations of humpback whales lingering at seamounts (Mate *et al.,* 2007), the purpose of these aggregations is not clear, and it may be that they are feeding, regrouping, or simply using them for navigation between feeding and breeding grounds (Fiedler, 2002; Mate *et al.,* 2007); therefore, the role of the seamount habitat is not clear. According to Pitcher *et al.* (2007), there have been very few observations of persistently high phytoplankton biomass (*i.e.,* high primary production, usually estimated from chlorophyll concentrations) over seamounts and, where such effects have been reported, all were from seamounts with summits shallower than 300 m and the effects were not persistent, lasting only a few days at most. Therefore, it may be that food sources for many baleen whales are not concentrated in great enough quantities for significant enough time periods to serve as important feeding areas. While some odontocete (toothed) whales have been suggested to utilize seamount features for prey capture (Pitcher *et al.* (2007)), the authors conclude that the available evidence suggests that, ‘‘unlike many other members of seamount communities, the vast majority of marine mammal species are probably only loosely associated with particular seamounts.’’

Practicability

NMFS and the Navy evaluated the practicability of implementation of the White Paper's recommendation regarding seamounts that rise to within 500 m of the sea surface. The Navy has indicated, and NMFS concurs, that additional restrictions within 100 km of all islands and seamounts that rise to within 500 m of the surface beyond the existing coastal standoff and OBIAs would unacceptably impact their national security mission. The mission of SURTASS LFA sonar is to detect quieter and harder to-find foreign submarines at greater distances. Seamounts provide complex bathymetric and oceanographic conditions that can be used by submarines to hide and avoid detection. Training, testing and operations in and around seamounts is vitally important for the Navy to understand how these features can be exploited to evade detection. If the Navy's use of SURTASS was restricted within 100 km of these features, the Navy would not have the benefit of being able to train and operate in these challenging environments, while adversaries would use these distinctive geographic features to their advantage. Year-round access to all of these areas of challenging topography and bathymetry is necessary, as the Navy cannot telegraph to potential adversaries that it will not be operating in specific seamounts areas for long periods of time.

Conclusion

In summary, while restricting LFA sonar use in areas 100 km seaward from islands and seamounts could potentially reduce take numbers for some individuals within a limited number of species and potentially provide some additional protection of preferred habitat in some cases (potential feeding), data indicate that marine mammal associations with these areas are limited, and the benefits would be, at best, ephemeral. Furthermore, the potential avoidance would likely be more associated with mid-frequency and high frequency species, while low frequency species are more of a concern for potential effects. Limiting SURTASS LFA sonar activities in these large areas when activities are already comparatively low (four ships each operating a maximum of 255 transmission hours spread across expansive distances and an entire year), and the existing risks to the affected species and stocks are comparatively low (limited to lower level Level B behavioral harassment), would provide limited additional benefit to individual marine mammals, but would not change the effect on the population, species, or stock. Given the limited potential for additional reduction of impacts to a small number of marine mammal species and the high degree of impracticability (serious impacts on mission effectiveness), NMFS has preliminarily determined that this measure should not be required.

High Productivity Regions That Are Not Included in the Continental Shelf, Continental Slope, Seamount, and Island Ecosystems

Reduction of Adverse Impacts to Marine Mammal Species and Stocks and Their Habitat

Regions of high productivity have the potential to be important foraging habitat for some species of marine mammals at certain times of the year and could potentially correlate with either higher densities and/or feeding behaviors through parts of their area. Productive areas of the ocean are difficult to consistently define due to interannual spatial and temporal variability. High productivity areas have ephemeral boundaries that are difficult to define and do not always persist interannually or within the same defined region. While there is not one definitive guide to the productive areas of the oceans, NMFS and the Navy examined these areas in the 2017/2018 SURTASS operation area.

These areas are typically very large, which means that animals are not constrained in high densities in a particular feeding area and there are typically ample alternative opportunities to move into, or within, other parts of these high productivity areas should they choose to avoid the area around the SURTASS vessel. Additionally, these areas are often associated with coastal areas, for instance, Houston and Wolverton (2009) show areas of high/highest productivity that are either (1) confined to high latitude (polar) areas that are not in the SURTASS LFA sonar operational area, or (2) very coastally and typically seasonally associated with areas of high coastal run off (*i.e.*. by mouth of Mississippi River, mouth of Amazon river), which are already encompassed by the coastal standoff range. Additionally, as noted above, given the current mitigation scheme for SURTASS LFA sonar, the existing risk to marine mammal species and stocks is low and is limited to Level B harassment (significant disruption or abandonment of behavioral patterns) due to existing mitigation measures.

Practicability

NMFS and the Navy evaluated the practicability of implementation of the White Paper's recommended restrictions on high productivity. The Navy has indicated, and NMFS concurs, that additional restrictions in high productivity regions that are not included in the continental shelf, continental slope, seamount, and island ecosystems beyond the existing coastal standoff and OBIAs would unacceptably impact their national security mission. The mission of SURTASS LFA sonar is to detect quieter and harder to-find foreign submarines at greater distances. For the system to perform its national defense function, the Navy must operate within coastal, littoral waters, which may include high productivity areas, in order to track relevant targets. If large areas of the ocean were excluded from potential usage, the Navy would not have the benefit of being able to train and operate in these challenging environments, while adversaries would use these distinctive geographic features to their advantage. Year-round access to all of these areas of challenging topography and bathymetry is necessary as the Navy cannot telegraph to potential adversaries that it will not be operating in large parts of the ocean for long periods of time. Also, because high productivity areas are highly variable and ephemeral, implementation would not be operationally practicable for the Navy.

Conclusion

Restricting use of SURTASS LFA sonar seasonally in high productivity areas could potentially reduce take numbers for certain species and potentially provide some additional protection of preferred or feeding habitat in some cases. However, as noted above, the size of the primary productivity areas is such that animals could likely easily access adjacent high productivity areas should they be temporarily diverted away from a particular area due to a SURTASS LFA sonar source. In addition, marine mammals are certainly not concentrated through all or even most of these large areas for all or even most of the time when productivity is highest, so a broad limitation of this nature would likely unnecessarily limit LFA sonar activities while providing negligible protective benefits to marine mammal species or stocks. Limiting activities in these large areas when activities are already comparatively low (four ships operating approximately 255 transmission hours spread across expansive ocean distances), and the existing risks to the affected species and stocks are comparatively low, would provide limited additional protection. Given the limited potential for additional reduction of impacts to marine mammal species and the high degree of impracticability (serious impacts on mission effectiveness), NMFS has preliminarily determined that this measure would not be required.

White Paper Overall Conclusion

In conclusion, NMFS has considered the White Paper recommendations. While we acknowledge that these measures could potentially reduce the numbers of take for some individual marine mammals within a limited number of species, or may add some small degree of protection to preferred habitat or feeding behaviors in certain circumstances, this limited and uncertain benefit to the affected species or stocks and their habitat is not justified when considered against the degree of impracticability for Navy implementation. This is especially true in light of the operational impacts and the anticipated success of the significant mitigation measures that the Navy has already been implementing (and which have provided a large degree of protection and have limited takes to lower level Level B behavioral harassment) to reduce impacts.

Overall Mitigation Conclusions

NMFS has determined preliminarily that the Navy's proposed mitigation measures together with the additional mitigation measures proposed by NMFS provide the means of effecting the least practicable adverse impacts on marine mammals species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and which include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity. NMFS provides further details in the following section.

NMFS believes that the shutdown in the LFA sonar mitigation and buffer zones, based on detection from highly effective visual monitoring, passive acoustic monitoring, active acoustic monitoring using HF/M3 sonar with ramp-up procedures, and geographic restriction measures proposed will enable the Navy to: (1) Avoid Level A harassment of marine mammals; (2) minimize the incidences of marine mammals exposed to SURTASS LFA sonar sound levels associated with TTS and higher levels of significant behavioral disruptions under Level B harassment; ands; and (3) minimize exposure of marine mammal takes in areas and during times of important behaviors, such as feeding, migrating, calving, or breeding based on the best available information.

The SURTASS LFA sonar signal is not expected to cause mortality, serious injury, PTS, or TTS due to implementation of the shutdown zone mitigation measures, which include the Navy's proposed 180 dB rms isopleth shutdown zone (LFA Mitigation Zone) as well as an additional 1 km buffer proposed by NMFS. Although the distance to the 180 dB isopleth is based on existing environmental conditions, the distance is frequently, but not always, approximately 1 km. Implementing an additional 1-km buffer zone increases the extent around the LFA sonar array and vessel, which will ensure that no marine mammals are exposed to an SPL greater than about 174 dB re: 1 μPa rms. As shown in Table 29 above, the TTS threshold for LF cetaceans, which are the hearing group most likely affected by SURTASS LFA sonar, is 179 dB SEL. A low-frequency cetacean would need to remain within 41 meters (135 ft) for an entire LFA sonar transmission (60 seconds) to potentially experience PTS and within 413 m (1,345 ft) for an entire LFA sonar transmission (60 seconds) to potentially experience TTS. Therefore, implementation of the shutdown zone mitigation measures would minimize the potential for LF cetaceans to be exposed to LFA sonar at levels associated with the onset of TTS. The best information available indicates that effects from SPLs less than 180 dB re: 1 μPa will be limited to short-term, Level B behavioral harassment, and animals are expected to return to behaviors shortly after exposure.

As described above, NMFS has included a robust suite of mitigation measures for world-wide SURTASS LFA sonar operation that: Minimize or alleviate the likelihood of injury, TTS, or more severe behavioral responses due to implementation of shutdown measures (implementation of the LFA mitigation zone plus a 1 km buffer); minimize or avoid behavioral impacts in important areas where these impacts would be more likely to have negative energetic effects, or deleterious effects on reproduction, which could reduce the likelihood of survival or reproductive success (measures to avoid or lessen exposures of marine mammals within OBIAs); and generally lessen the total number of takes of many species due to implementation of coastal standoff measures. These measures, taken together, constitute the means of effecting the least practicable adverse impact on the affected species and stocks worldwide and for operating areas in the upcoming annual LOA period. We also carefully evaluated the potential inclusion of additional measures in data-poor areas (White Paper recommendations) before reaching this conclusion. With regard to habitat, NMFS has not identified any impacts to habitat from SURTASS LFA sonar that persist beyond the time and space that the impacts to marine mammals themselves could occur. Therefore, the mitigation measures that address important areas that serve as important habitat for marine mammals in all or part of the year (*i.e.,* OBIAs and the coastal standoff), appropriately address effects on marine mammal species and stocks and their habitat.

In the 2012 rule, NMFS and the Navy annually considered how new information, from anywhere in the world, should be considered in an adaptive management context—including whether this new information would support the identification of new OBIAs or other mitigation measures. Moving forward, new information will still be considered annually, but only in the context of the area in which SURTASS LFA assets will be operating in that year. This approach makes sense because it is not possible to conduct a meaningful practicability analysis on a measure in an area where SURTASS is not deployed and there are no real details to apply to the analysis. Additionally, evaluating potential additional measures in areas that will not be used is not a good use of agency resources. Should SURTASS LFA sonar deploy to new action areas during the time period covered by this proposed rule, NMFS will reconsider the recommendations made in the White Paper in the context of those specific areas and operational considerations in advance of any potential LOA issuance in that area, and publish our evaluation in the associated FR notice.

Proposed Monitoring

Section 101(a)(5)(A) of the MMPA states that in order to issue an ITA for an activity, NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for LOAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking, or impacts on populations of marine mammals that are expected to be present.

Monitoring measures prescribed by NMFS should accomplish one or more of the following general goals:

- An increase in our understanding of how many marine mammals are likely to be exposed to levels of LFA sonar that we associate with specific adverse effects, such as disruption of behavioral patterns and TTS (Level B harassment), or PTS.
- An increase in our understanding of how individual marine mammals respond (behaviorally or physiologically) to LFA sonar (at specific received levels or other stimuli expected to result in take).
- An increase in our understanding of how anticipated takes of individuals (in different ways and to varying degrees) may impact the population, species, or stock (specifically through effects on annual rates of recruitment or survival).
- An increase in knowledge of the affected species.
- An increase in our understanding of the effectiveness of certain mitigation and monitoring measures.
- A better understanding and record of the manner in which the authorized entity complies with the incidental take authorization.
- An increase in the probability of detecting marine mammals, both within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general to better achieve the above goals.

In addition to the real-time monitoring associated with mitigation, the Navy is engaging in exploring other monitoring efforts described here:

Marine Mammal Monitoring (M3) Program

The Marine Mammal Monitoring (M3) Program uses the Navy's fixed and mobile passive acoustic monitoring systems to monitor the movements of some large cetaceans (principally baleen whales), including their migration and feeding patterns, by tracking them through their vocalizations.

At present, the M3 Program's data are classified, as are the data reports created by M3 Program analysts, due to the inclusion of sensitive national security information. The Navy (OPNAV N2/N6F24) continues to assess and analyze M3 Program data collected from Navy passive acoustic monitoring systems and is working toward making some portion of that data (after appropriate security reviews) available to scientists with appropriate clearances and ultimately to the public (D0N, 2015). Progress has been achieved on addressing securing concerns and declassifying the results of a specific dataset pertinent to a current area of scientific inquiry for which a peer-reviewed scientific paper is being prepared for submission to a scientific journal.

Due to research indicating that beaked whales and harbor porpoises may be particularly sensitive to a range of underwater sound (Southall et al., 2007; Tyack et al., 2011; Kastelein et al., 2012), in the 2012 rule and LOAs for these activities, NMFS included conditions for understanding of the potential effects of SURTASS LFA sonar on these taxa. The Navy convened an independent Scientific Advisory Group (SAG), whose purpose was to investigate and assess different types of research and monitoring methods that could increase the understanding of the potential effects to beaked whales and harbor porpoises from exposure to SURTASS LFA sonar transmissions. The SAG was composed of six scientists affiliated with two universities, one Federal agency (NMFS), and three private research and consultancy firms. The SAG prepared and submitted a report, entitled, ''Potential Effects of SURTASS LFA Sonar on Beaked Whales and Harbor Porpoises,'' describing the SAG's monitoring and research recommendations. In August 2013, the SAG report was submitted to the Navy, NMFS, and the Executive Oversight Group (EOG) for SURTASS LFA sonar.

The EOG is comprised of representatives from the U.S. Navy (Chair, OPNAV N2/N6F24), Office of the Deputy Assistant Secretary of the Navy for the Environment, Office of Naval Research, Navy Living Marine Research Program, and the NMFS Office of Protected Resources (OPR) (Permits, Conservation, and Education Division). Representatives of the Marine Mammal Commission have also attended EOG meetings as observers. The EOG for SURTASS LFA sonar met twice in 2014 to review and further discuss the research recommendations put forth by the SAG, the feasibility of implementing any of the research efforts, and existing budgetary constraints. In addition to the research and monitoring efforts recommended by the SAG, additional promising suggestions for research/monitoring were recommended for consideration by the EOG. The EOG is considering which research/monitoring efforts are the most efficacious, given existing budgetary constraints, and will provide the Navy with a ranked list of research/monitoring recommendations. The EOG also determined that a study should be conducted to determine the extent of the overlap between potential LFA sonar operations and the distributional range of harbor porpoises; the Navy is in the process of finalizing this study. Following completion of all EOG consideration and evaluation, the Navy will prepare a research action plan for submittal to the NMFS Office of Protected Resources outlining the way forward (DoN, 2015). The Navy is committed to completing its assessment of the validity, need, and recommendations for field and/or laboratory research on the potential effects of SURTASS LFA sonar on beaked whales and harbor porpoises.

Ambient Noise Data Monitoring

Several efforts (federal and academic) are underway to develop a comprehensive ocean noise budget (*i.e.,* an accounting of the relative contributions of various underwater sources to the ocean noise field) for the world's oceans that include both anthropogenic and natural sources of noise. Ocean noise distributions and noise budgets are used in marine mammal masking studies, habitat characterization, and marine animal impact analyses.

The Navy will collect ambient noise data when the SURTASS passive towed horizontal line array is deployed. However, because the collected ambient noise data may also contain sensitive acoustic information, the Navy classifies the data, and thus does not make these data publicly available. The Navy is exploring the feasibility of declassifying and archiving portions of the ambient noise data for incorporation into appropriate ocean noise budget efforts after all related security concerns have been resolved.

Research

The Navy sponsors significant research and monitoring projects for marine living resources to study the potential effects of its activities on marine mammals. N2/N6 provides a representative to the Navy's Living Marine Resources advisory board to provide input to future research projects that may address SURTASS LFA sonar needs. In Fiscal Year 2014, the Navy reported that it spent $29.6 million (M) on marine mammal research and conservation during that year. This ongoing marine mammal research relates to hearing and hearing sensitivity, auditory effects, marine mammal monitoring and detection, noise impacts, behavioral responses, diving physiology and physiological stress, and distribution. The Navy sponsors a significant portion of U.S. research on the effects of human-generated underwater sound on marine mammals and approximately 50 percent of such research conducted worldwide. These research projects may not be specifically related to SURTASS LFA sonar activities; however, they are crucial to the overall knowledge base on marine mammals and the potential effects from underwater anthropogenic noise. The Navy also sponsors research to determine marine mammal abundances and densities for all Navy ranges and other operational areas. The Navy notes that research and evaluation is being carried out on various monitoring and mitigation methods, including passive acoustic monitoring, and the results from this research could be applicable to SURTASS LFA sonar passive acoustic monitoring. The Navy has also sponsored several workshops to evaluate the current state of knowledge and potential for future acoustic monitoring of marine mammals. The workshops bring together underwater acoustic subject matter experts and marine biologists from the Navy and other research organizations to present data and information on current acoustic monitoring research efforts, and to evaluate the potential for incorporating similar technology and methods on Navy instrumented ranges.

Adaptive Management

Our understanding about marine mammals and the potential effects of SURTASS LFA sonar on marine mammals is continually evolving. Reflecting this, the proposed rule again includes an adaptive management framework that is supported by the Navy's 2016 SEIS/SOEIS. This allows the agencies to consider new/revised peer-reviewed and published scientific data and information from qualified and recognized sources within academia, industry, and government/non-government organizations to determine (with input regarding practicability) whether SURTASS LFA sonar mitigation, monitoring, or reporting measures should be modified (including additions or deletions) and to make such modification if new scientific data indicate that they would be appropriate. Modifications that are substantial would be made only after a 30-day period of public review and comment. Substantial modifications include a change in mission areas or new information that results in significant changes to mitigation. The framework also allows for updates to marine mammal stock estimates and newly classified species or stocks to be included in annual LOA applications, which, in turn, provides for the use of the best available scientific data for predictive models, including the Acoustic Integration Model © (AIM).

As discussed in the Mitigation section above, NMFS and Navy have refined the adaptive management process for this rule compared to previous rulemakings. New information will still be considered annually, but only in the context of the area in which SURTASS LFA assets will operate in that year. This approach allows a more focused and productive use of resources by evaluating only areas where SURTASS LFA sonar will be operating.

Proposed Reporting

In order to issue an ITA for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring. There are several different reporting requirements in these proposed regulations:

General Notification of Injured or Dead Marine Mammals

The Navy will systematically observe SURTASS LFA sonar activities for injured or disabled marine mammals. In addition, the Navy will monitor the principal marine mammal stranding networks and other media to correlate analysis of any whale mass strandings that could potentially be associated with SURTASS LFA sonar activities.

Navy personnel will ensure that NMFS is notified immediately or as soon as clearance procedures allow if an injured, stranded, or dead marine mammal is found during or shortly after, and in the vicinity of, any SURTASS LFA sonar activities. The Navy will provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available).

In the event that an injured, stranded, or dead marine mammal is found by the Navy SURTASS LFA sonar vessel crew during transit, or that is not in the vicinity of, or found during or shortly after SURTASS LFA sonar activities, the Navy will report the same information as listed above as soon as operationally feasible and clearance procedures allow.

General Notification of a Ship Strike

Because SURTASS LFA vessels move slowly, it is not likely these vessels would strike a marine mammal. In the event of a ship strike by the SURTASS LFA vessel, at any time or place, the Navy shall do the following:

- Immediately report to NMFS the species identification (if known), location (lat/long) of the animal (or the strike if the animal has disappeared), and whether the animal is alive or dead (or unknown);
- Report to NMFS as soon as operationally feasible the size and length of the animal, an estimate of the injury status (*e.g.,* dead, injured but alive, injured and moving, unknown, etc.), vessel class/type and operational status;
- Report to NMFS the vessel length, speed, and heading as soon as feasible; and
- Provide NMFS a photo or video, if equipment is available.

Quarterly Mitigation Monitoring Report

On a quarterly basis, the Navy would provide NMFS with classified and unclassified reports that include all active-mode missions for each SURTASS LFA sonar vessel. The Navy would provide the quarterly mission reports no later than 45 days following the end of each quarter, beginning on the effective date of the annual LOA. Specifically, the classified reports will include dates/times of exercises, location of vessel, mission operational area, location of the mitigation zone in relation to the LFA sonar array, marine mammal observations, and records of any delays or suspensions of activities. Marine mammal observations would include animal type and/or species, number of animals sighted by species, date and time of observations, type of detection (visual, passive acoustic, HF/M3 sonar), the animal's bearing and range from vessel, behavior, and remarks/narrative (as necessary). The quarterly reports would include the Navy's analysis of take by Level A and/or Level B harassment, estimates of the percentage of marine mammal stocks affected (both for the quarter and cumulatively (to date) for the year covered by the LOA) by SURTASS LFA sonar activities. The Navy's estimates of the percentage of marine mammal stocks and number of individual marine mammals affected by exposure to SURTASS LFA sonar transmissions would be derived using acoustic impact modeling based on operating locations, season of missions, system characteristics, oceanographic environmental conditions, and marine mammal demographics. In the event that no SURTASS LFA missions are completed during a quarter, the Navy will provide NMFS with a report of negative activity for each SURTASS LFA sonar vessel.

Annual Report

The annual report, which is due no later than 60 days after the expiration date of the annual LOAs, would provide NMFS with an unclassified summary of the year's quarterly reports including estimations of total percentages of each marine mammal stock affected by all SURTASS LFA sonar transmissions during the annual period using predictive modeling based on operating locations, dates/times of operations, system characteristics, oceanographic environmental conditions, and animal demographics.

Additionally, the annual report would include: (1) Analysis of the effectiveness of the mitigation measures with recommendations for improvements where applicable; (2) assessment of any long-term effects from SURTASS LFA sonar activities; and (3) any discernible or estimated cumulative impacts from SURTASS LFA sonar activities.

Comprehensive Report

NMFS proposes to require the Navy to provide NMFS and the public with a final comprehensive report analyzing the impacts of SURTASS LFA sonar on marine mammal species and stocks. This report would include an in-depth analysis of all monitoring and Navy-funded research pertinent to SURTASS LFA sonar activities conducted during the 5-year period of these regulations, a scientific assessment of cumulative impacts on marine mammal stocks, and an analysis on the advancement of alternative (passive) technologies as a replacement for LFA sonar. This report would be a key document for NMFS' review and assessment of impacts for any future rulemaking.

The Navy shall respond to NMFS comments and requests for additional information or clarification on the quarterly, annual or comprehensive reports. These reports will be considered final after the Navy has adequately addressed NMFS' comments or provided the requested information, or three months after the submittal of the draft if NMFS does not comment within the three-month time period. NMFS will post the annual and comprehensive reports on the internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications*.

Estimated Take of Marine Mammals

This section includes an estimate of the number of incidental takes proposed for authorization pursuant to this rulemaking, which will inform NMFS' consideration of the negligible impact determination.

Harassment is the primary means of take expected to result from these activities. For this military readiness activity, the MMPA defines ''harassment'' as: (i) Any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavior patterns, including but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered (Level B Harassment). As described previously in the Potential Effects of the Specified Activity on Marine Mammals and their Habitat section, Level B Harassment is expected to occur and is proposed to be authorized as a maximum of 12 percent takes by Level B harassment per stock annually, and the Navy will use the 12 percent limit to guide its mission planning and annual LOA applications. Numbers and percentages of marine mammals and marine mammal stocks will be provided by the Navy in their annual application for LOAs, based on the mission areas for which the Navy anticipated SURTASS LFA sonar activities for that year.

Based on the nature of the activities and the anticipated effectiveness of the mitigation measures, take by Level A Harassment is neither anticipated nor proposed to be authorized. The Navy's acoustic impact analysis for marine mammals represents an evolution that builds upon the analysis, methodology, and impact criteria documented in previous SURTASS LFA sonar NEPA efforts (DoN, 2001; 2007; 2012; 2015), and includes updates of the most current acoustic impact criteria and methodology to assess acoustic impacts (NMFS, 2016). A detailed discussion of the acoustic impact analysis is provided in Appendix B of the Navy's DSEIS/SOEIS, but is summarized here. Using AIM, the Navy modeled 26 representative mission areas in the Pacific, Atlantic, and Indian Oceans, as well as the Mediterranean Sea, representing the acoustic regimes and marine mammal species that may be encountered worldwide during SURTASS LFA sonar activities. To estimate real-world exposure estimates, the Navy used AIM to take the ship movement and speed, as well as LFA sonar transmissions, into account, and to simulate the modeled marine mammal species by creating animats programmed with behavioral values representative of the species, using density estimates for modeled species in each of the representative mission areas.

Density Estimates

To derive density estimates, direct estimates from line-transect surveys that occurred in or near each of the 26 mission areas were utilized first (*e.g.,* Barlow, 2006). However, density estimates were not always available for each species at all sites. When density estimates were not available from a survey in the operational area, density estimates from a region with similar oceanographic characteristics were extrapolated to the operational area. Densities for some mission areas/model sites were also derived from the Navy's Marine Species Density Database (DoN, 2016). Last, density estimates are usually not available for rare marine mammal species or for those that have been newly defined (*e.g.,* Deraniyagala's beaked whale). For such species, a low density estimate of 0.0001 animals per square kilometer (animals/km^2) was used in the risk analysis to reflect the low probability of occurrence in a specific mission area. Further, density estimates are sometimes pooled for species of the same genus if sufficient data are not available to compute a density for individual species or the species are difficult to distinguish at sea. This is often the case for pilot whales and beaked whales, as well as the pygmy and dwarf sperm whales. Density estimates are available to these species groups rather than the individual species. Density information is provided in Tables 3–28 above, and is also available in the Navy's application (Table 3–2, Pages 3–9 through 3–36).

Estimates of Potential Marine Mammal Exposure

The process of estimating the marine mammal takes that may result from the proposed operation of SURTASS LFA sonar begins with the pertinent Navy commands proposing mission areas in which SURTASS LFA sonar may be operated. The Navy performs standard acoustic modeling and impact analyses, taking into account spatial, temporal, and/or operational parameters to determine the potential for PTS, TTS, or behavioral responses for each individual marine mammal. Then, the Navy applies standard mitigation measures (180–dB rms shutdown criteria) to the analysis to calculate take estimates for Level A harassment of marine mammal stocks in the proposed mission area. Based on these estimates, the Navy determines that the proposed missions meet the conditions of the MMPA incidental take regulation and LOAs, as issued (*i.e.,* 12 percent Level B harassment limit per stock), for SURTASS LFA sonar. On a quarterly basis, the duration of actual sonar transmissions is recorded and compared to the predicted missions, as well as summed across the annual LOA period, to ensure that no more than 12% of any stock has been taken by Level B incidental harassment.

The Navy assesses the potential impacts on marine mammals by predicting the sound field that a given marine mammal species could be exposed to over time in a potential mission area. This is a multi-part process involving: (1) The ability to measure or estimate an animal's location in space and time; (2) the ability to measure or estimate the three-dimensional sound field at these times and locations; (3) the integration of these two data sets into the acoustic impact model to estimate the total acoustic exposure for each animal in the modeled population; and (4) the conversion of the resultant cumulative exposures for a modeled population into an estimate of the risk of a disruption of natural behavioral patterns or TTS (*i.e.,* a take estimate for Level B harassment) or of potential injury (*i.e.,* Level A harassment).

The Navy estimated the three-dimensional sound field using its standard parabolic equation (PE) transmission loss model. The results of this model are the primary input to the AIM, which the Navy used to estimate marine mammal sound exposures. AIM integrates simulated movements (including dive patterns) of marine mammals, a schedule of SURTASS LFA sonar transmissions, and the predicted sound field for each transmission to estimate acoustic exposure during a hypothetical SURTASS LFA sonar operation in each proposed mission area seasonally. A description of the PE and AIM models, including AIM input parameters for animal movement, diving behavior, and marine mammal distribution, abundance, and density are all described in detail in the Navy's application and in the Navy's DSEIS/SOEIS (see Appendix B for detailed information on the Marine Mammal Impact Analysis). NMFS has reviewed this information and has accepted the Navy modeling procedure and results.

The acoustic impact analysis for this effort represents an evolution that builds upon the analysis, methodology, and impact criteria documented in previous SURTASS LFA sonar efforts summarized below (DoN, 2001; 2007; and 2012), but incorporates the most current acoustic impact criteria and methodology to assess the potential for auditory impacts and the best available data on behavioral responses of marine mammals to SURTASS LFA sonar. In addition, the Navy continuously updates the analysis with new marine mammal biological data (behavior, distribution, abundance and density) whenever new information becomes available.

Because it is infeasible to model all potential LFA sonar operating areas worldwide, the Navy's application presents 26 modeled sites as examples to provide estimates of potential mission areas based on the current political climate. The Navy analyzed these 26 mission areas using the most up-to-date marine mammal abundance, density, and behavioral information available. These sites represent areas where SURTASS LFA sonar activities could potentially occur based on today's political climate. Table 6–2 of the Navy's application (pages 6–14 through 6–34) provides the Navy's estimates of the percentage of marine mammal stocks potentially affected by SURTASS LFA sonar activities based on reasonable and realistic estimates of the potential effects to marine mammal stocks specific to the potential mission areas. These data are examples of areas where the Navy could request LOAs under the 5-year rule because they are in areas of potential strategic importance and/or areas of possible naval fleet exercises. The percentage of marine mammal stocks that may experience TTS or behavioral changes from LFA sonar exposures was calculated for one season in each of the 26 representative mission areas. The noise exposure scenario was also for a 24-hour period with LFA sonar transmitting 60-second signals every ten minutes for the entire period. Based on historical mission data, it is unlikely that such a scenario would occur, but is a conservative method for estimating potential impacts. As stated previously, this proposed rule calculates percentages of marine mammal species or stocks and does not specify the number of marine mammals that may be taken in the proposed locations because these are determined annually through various inputs such as mission location, mission duration, and season of operation and are included in the application for LOAs due to the fact that the Navy cannot know where they will need to operate each year over the five-year effective period of the proposed rule. For the annual application for an LOA, the Navy identifies the mission areas and proposes to present both the estimated percentage of a stock incidentally harassed as well as the estimated number of animals by species or stock that may be potentially harassed by SURTASS LFA sonar in each of the proposed mission areas for that annual period.

With the implementation of the three-part monitoring programs (visual, passive acoustic, and HF/M3 monitoring), NMFS and the Navy do not expect that marine mammals would be injured by SURTASS LFA sonar because a marine mammal should be detected and active transmissions suspended or delayed. The probability of detection of a marine mammal by the HF/M3 system within the LFA sonar mitigation zone approaches 100 percent based on multiple pings (see the 2001 FOEIS/EIS, Subchapters 2.3.2.2 and 4.2.7.1 for the HF/M3 sonar testing results). Quantitatively, modelling output shows zero takes by Level A harassment for all marine mammal stocks in all representative mission areas with mitigation applied. As noted above, all hearing groups of marine mammals would need to be within 22 ft (7 m) for an entire LFA transmission (60 seconds), and a LF cetacean would need to be within 135 ft (41 m) for an entire LFA transmission to potentially experience PTS. This is unlikely to occur, especially given the mitigation measures in place and their proven effectiveness at detecting marine mammals well outside of this range so that shut down measures would be implemented well before marine mammals would be within these ranges. Again, NMFS notes that over the course of the previous three rulemakings, there have been no reported or known incidents of Level A harassment of any marine mammal. Therefore, NMFS will not authorize any Level A takes for any marine mammal species or stocks over the course of the 5-year regulations. To potentially experience TTS, marine mammals would need to be at farther distances, but still within the approximately 2-km shutdown distance. The distances to the TTS thresholds are less than 50 ft (15 m) for MF and HF cetaceans and otariids, 216 ft (66 m) for phocids, and 1,354 ft (413 m) for LF cetaceans, if an animal were to remain at those distances for an entire LFA sonar signal (60 sec). While it is likely that mitigation measures would also avoid TTS, some small subset of the animals exposed above the Level B harassment threshold may also experience TTS. Any TTS incurred would likely be of a low level and of short duration because we do not expect animals to be exposed for long durations close to the source.

As with the previous rules, the Navy will limit operation of SURTASS LFA sonar to ensure no marine mammal stock will be subject to more than 12 percent of the individuals of any stock taken by Level B harassment annually, during the five-year regulations. This annual per-stock cap applies regardless of the number of LFA vessels operating. The Navy will use the 12 percent cap to guide its mission planning and annual LOA applications.

As discussed, the Navy uses a behavioral response function to estimate the number of behavioral responses that would qualify as Level B behavioral harassment under the MMPA. As the statutory definition is currently applied, a wide range of behavioral reactions may qualify as Level B harassment under the MMPA, including but not limited to avoidance of the sound source, temporary changes in vocalizations or dive patterns, temporary avoidance of an area, or temporary disruption of feeding, migrating, or reproductive behaviors. The estimates calculated using the behavioral response function do not differentiate between the different types of potential behavioral reactions. Nor do the estimates provide information regarding the potential fitness or other biological consequences of the reactions on the affected individuals.

NMFS notes that legislative history suggests that Congress intended that Level B harassment be limited to behavioral disturbances that have ''demographic consequences to reproduction or survivability of the species.'' H.R. Conf. Rep. 108–354 (2003), 108th Cong., 1st Sess., reprinted in 2004 U.S.C.C.A.N. 1407, 1447. However, no methodology currently exists that would allow the Navy to estimate each type of potential behavioral response, predict any long-term consequences for the affected mammals, and then limit its take request to only the most severe responses that could have demographic consequences to reproduction or survivability. Therefore, as described above, the Navy's take estimates capture a wider range of less significant responses. NMFS does not assume that each instance of Level B harassment modeled by the Navy has, or is likely to have, an adverse population-level impact. Rather, NMFS considers the available scientific evidence to determine the likely nature of the modeled behavioral responses and the potential fitness consequences for affected individuals in its negligible impact evaluation.

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering the numbers of marine mammals that might be taken through harassment, NMFS considers other factors, such as the likely nature of any responses (*e.g.,* intensity and duration), the context of any response (*e.g.,* critical reproductive time or location, migration, etc.), as well as effects on habitat, the status of the affected stocks, and the likely effectiveness of the mitigation. Consistent with the 1989 preamble for NMFS' implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into these analyses via their impacts on the environmental baseline (*e.g.,* as reflected in the regulatory status of the species, population size, and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

To avoid repetition, the discussion of our analyses applies to all the stocks listed in Tables 3 through 28, given that the anticipated effects of this activity on these different marine mammal stocks are expected to be similar, given the operational parameters of the activity. While there are differences in the hearing sensitivity of different groups, these differences have been factored into the analysis for auditory impairment. However, the nature of their behavioral responses is expected to be similar for SURTASS LFA sonar, especially given the context of their short duration open ocean exposures. Additionally, because of the comparatively small percentage of any population expected to be taken, combined with the operational avoidance of areas that are known to be important for specific biologically important reasons and the anticipated low-level effects, there is no need to differentially evaluate species based on varying status.

The Navy has described its specified activities based on best estimates of the number of hours that the Navy will conduct SURTASS LFA activities. The exact number of transmission hours may vary from year to year, but will not exceed the annual total of 225 transmission hours per vessel per year as indicated in Table 1. This has been reduced from previous SURTASS LFA sonar rulemakings, which evaluated and authorized 432 transmission hours per vessel per year. We note that this reduction in transmission hours represents a 41% reduction in sonar hours per ship during this next rulemaking period, which corresponds to less exposure and lessened takes compared to previous rules.

As mentioned previously, NMFS estimates that 104 species of marine mammals could be taken by Level B harassment over the course of the five-year period. For reasons stated previously in this document, no mortalities are anticipated to occur as a result of the Navy's proposed SURTASS LFA sonar activities, and none are proposed to be authorized by NMFS. The Navy has operated SURTASS LFA sonar under NMFS regulations for the last fourteen years without any reports of serious injury or death. The evidence to date, including recent scientific reports and annual monitoring reports, and fourteen years of experience conducting SURTASS LFA activities further supports the conclusion that the potential for injury, and particularly serious injury, to occur is minimal.

Taking the above into account, considering the sections discussed further, and dependent upon the implementation of the proposed mitigation measures, NMFS has preliminarily determined that use of SURTASS LFA sonar during activities will have a negligible impact on the marine mammal species and stocks present in operational areas in the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea, as listed in Tables 3–28 above.

There is no empirical evidence of strandings of marine mammals associated spatially or temporally with the employment of SURTASS LFA sonar. Moreover, the sonar system acoustic characteristics differ between LFA sonar and MF sonars that have been associated with strandings: LFA sonars use frequencies from 100 to 500 Hz, with relatively long signals (pulses) on the order of 60 sec; while MF sonars use frequencies greater than 1,000 Hz, with relatively short signals on the order of 1 sec. NMFS has provided a summary of common features shared by the stranding events in Greece (1996), Bahamas (2000), Madeira (2000), Canary Islands (2002), Hanalei Bay (2004), and Spain (2006) earlier in this document. These included operation of MF sonar, deep water close to land (such as offshore canyons), presence of an acoustic waveguide (surface duct conditions), and periodic sequences of transient pulses (*i.e.,* rapid onset and decay times) generated at depths less than 32.8 ft (10 m) by sound sources moving at speeds of 2.6 m/s (5.1 knots) or more during sonar operations (D'Spain *et al.,* 2006). None of these features relate to SURTASS LFA sonar activities.

Implementing a shutdown zone of approximately 2 km (1.2 mi; 1.1 nmi, which is comprised of the LFA mitigation zone plus a 1-km buffer zone) around the LFA sonar array and vessel will ensure that no marine mammals are exposed to an SEL that would cause PTS or TTS. The proposed mitigation measures would allow the Navy to avoid exposing marine mammals to received levels of SURTASS LFA sonar or HF/M3 sonar sound that would result in injury (Level A harassment) and, as discussed in the Estimated Take of Marine Mammals section, most TTS (Level B harassment) would also be avoided due to mitigation measures, so that the majority of takes would be expected to be in the form of behavioral harassment (lower-level Level B harassment).

As noted above, the context of exposures is important in evaluating the ultimate impacts of the take on the individuals. In the case of SURTASS LFA sonar, the approaching sound source would be moving through the open ocean at low speeds, so concerns of noise exposure are somewhat lessened in this context compared to situations where animals may not be as able to avoid strong or rapidly approaching sound sources. In addition, the duration of the take is important in the case of SURTASS LFA sonar, as the vessel continues to move and any interruption of behavior would be of relatively short duration.

For SURTASS LFA sonar activities, the Navy provided information (Table 6–2 of the Navy's application) estimating percentages of marine mammal stocks that could potentially occur within the proposed 26 worldwide mission areas. Based on our evaluation, take from the specified activities associated with the proposed SURTASS LFA sonar activities will most likely fall within the realm of short-term and temporary, or ephemeral, disruption of behavioral patterns (Level B harassment). NMFS bases this assessment on a number of factors considered together:

(1) Geographic Restrictions—The OBIA and coastal standoff geographic restrictions on SURTASS LFA sonar activities are designed to minimize to the extent practicable the likelihood of disruption of marine mammals in areas where important behavior patterns such as migration, calving, breeding, feeding, or sheltering occur, or in areas with higher densities of marine mammals. As a result, the takes that occur are less likely to result in energetic effects or

disturbances that would reduce the reproductive success or survivorship.

(2) Low Frequency Sonar Scientific Research Program (LFS SRP)—The Navy designed the three-phase LFS SRP study to assess the potential impacts of SURTASS LFA sonar on the behavior of low-frequency hearing specialists, those species believed to be at (potentially) greatest risk due to the presumed overlap in hearing of these species and the frequencies at which SURTASS LFA sonar is operated. This field research addressed three important behavioral contexts for baleen whales: (1) Blue and fin whales feeding in the southern California Bight, (2) gray whales migrating past the central California coast, and (3) humpback whales breeding off Hawaii. Taken together, the results from the three phases of the LFS SRP do not support the hypothesis that most baleen whales exposed to RLs near 140 dB re: 1 μPa would exhibit disturbance or avoidance behaviors. These experiments, which exposed baleen whales to received levels ranging from 120 to about 155 dB re: 1 μPa, confirmed that some portion of the total number of whales exposed to LFA sonar responded behaviorally by changing their vocal activity, moving away from the source vessel, or both; but the responses were short-lived and animals returned to their normal activities within tens of minutes after initial exposure. These short-term behavioral responses do not necessarily constitute significant changes in biologically important behaviors. In addition, these experiments illustrated that the context of an exposure scenario is important for determining the probability, magnitude, and duration of a response. This was shown by the fact that migrating gray whales responded to a sound source in the middle of their migration route but showed no response to the same sound source when it was located offshore, outside the migratory corridor, even when the source level was increased to maintain the same received levels within the migratory corridor. Although this study is nearly two decades old, the collected behavioral response data remain valid and highly relevant, particularly since the information has been bolstered by other, more recent studies as discussed in the Behavioral Response/Disturbance section above. Therefore, take estimates for SURTASS LFA sonar are likely very conservative (though we analyze them here nonetheless), and takes that do occur will be limited to lower Level B harassment takes.

(3) Efficacy of the Navy's Three-Part Mitigation Monitoring Program—Review of Final Comprehensive and Annual Reports from August 2002 through August 2016 (14 years) indicates that the Navy has completed 171 missions and has reported 27 visual sightings, 11 passive acoustic detections, and 206 HF/M3 active sonar detections of marine mammals. The HF/M3 active sonar system has proven to be the most effective of the mitigation monitoring measures to detect possible marine mammals in proximity to the transmitting LFA sonar array, and use of this system substantially increases the probability of detecting marine mammals within the mitigation zone (and beyond), providing a superior monitoring capability. Because the HF/M3 active sonar is able to monitor large and medium marine mammals out to an effective range of 2 to 2.5 km (1.2 to 1.5 mi; 1.1 to 1.3 nmi) from the vessel, it is unlikely that the SURTASS LFA operations would expose marine mammals to an SPL greater than about 174 dB re: 1 μPa at 1 m. Past results of the HF/M3 sonar system tests provide confirmation that the system has a demonstrated probability of single-ping detection of 95 percent or greater for single marine mammals that are 10 m (32.8 ft) in length or larger, and a probability approaching 100 percent for multiple pings of any sized marine mammal. Lastly, as noted above, from the commencement of SURTASS LFA sonar use in 2002 through the present, neither operation of LFA sonar, nor operation of the T–AGOS vessels, has been associated with any mass or individual strandings of marine mammals. In addition, required monitoring reports indicate that there have been no apparent avoidance reactions observed, and no Level A harassment takes due to SURTASS LFA sonar since its use began in 2002 (see *Results from Past Monitoring,* above).

In examining the results of the mitigation monitoring procedures over the previous 14 years of SURTASS LFA activities, NMFS has concluded that the mitigation and monitoring measures for triggering shutdowns of the LFA sonar system have been implemented properly and have successfully minimized the potential adverse effects of SURTASS LFA sonar to marine mammals in the mitigation and buffer zone around the vessel. This conclusion is further supported by documentation that no known mortality or injury to marine mammals has occurred over this period.

For reasons discussed previously, NMFS anticipates that the effect of masking will be limited and the chances of an LFA sonar sound overlapping whale calls at levels that would interfere with their detection and recognition will be extremely low. Also as discussed previously, NMFS does not expect any short- or long-term effects to marine mammal food resources from SURTASS LFA sonar activities. It is unlikely that the activities of the four SURTASS LFA sonar vessels operating approximately 40 days maximum of LFA at any place in the action area over the course of a year would implicate all of the areas for a given species or stock in any year. It is anticipated that ample similar habitat areas are available for species/stocks in the event that portions of preferred areas are ensonified. Implementation of the LFA shutdown zone and additional 1-km buffer would ensure that most marine mammal takes are limited to lower-level Level B harassment. Further, in areas of known biological importance for functions such as feeding, reproduction, etc., effects are mitigated by OBIAs. As described previously, the Navy implements a 12% cap on affected species/stocks of marine mammals and, as indicated from previous monitoring reports, this level has generally never come close to being affected by SURTASS LFA sonar.

In summary (from the discussion above this section), NMFS has made a preliminary finding that the total taking from SURTASS LFA sonar activities will have a negligible impact on the affected species or stocks based on following: (1) The historical demonstrated effectiveness of the Navy's three-part monitoring program in detecting marine mammals and triggering shutdowns, which make it unlikely that an animal will be exposed to sound levels associated with potential injury or TTS; (2) Geographic restrictions requiring the SURTASS LFA sonar sound field not exceed 180 dB within 22 km of any shoreline, including islands, or at a distance of one km from the perimeter of an OBIA; (3) The small number of SURTASS LFA sonar systems that would be operating world-wide (likely not in close proximity to one another); (4) The relatively low duty cycle, short mission periods and offshore nature of the SURTASS LFA sonar; (5) The fact that marine mammals in unspecified migration corridors and open ocean concentrations would be adequately protected from exposure to sound levels that would result in injury, TTS, and more severe levels of behavioral disruption by the three-part monitoring and mitigation protocols; and (6) Monitoring results from the previous fourteen years of SURTASS LFA sonar activities show that take numbers have been well below the 12 percent cap for Level B harassment for each stock, and there have been no Level A takes.

Impacts to marine mammals are anticipated to be predominantly in the form of lower-level Level B behavioral harassment, due to the brief duration and sporadic nature of the SURTASS LFA sonar activities. For example, certain species may have a behavioral reaction (such as increased swim speed, avoidance of the area, etc.) to the sound emitted during the proposed activities.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the proposed activity will have a negligible impact on all affected marine mammal species or stocks.

Subsistence Harvest of Marine Mammals

Although the Navy will not operate SURTASS LFA sonar in the vast majority of Arctic waters, the Navy may potentially operate LFA sonar in the Gulf of Alaska or southward off the Aleutian Island chain, where subsistence uses of marine mammals under NMFS jurisdiction occur. Seven species of pinnipeds, one species of odontocetes (beluga whale), and one species of mysticetes (bowhead whale) are targeted by subsistence hunting in Alaska. The stocks of beluga whales that experience Alaska Native subsistence hunting are located in the Arctic waters and would not be impacted by SURTASS LFA sonar. The Western Arctic stock of bowhead whales experience subsistence hunting from Alaska, Canadian, and Russian Natives, but would not occur in the operational areas of SURTASS LFA sonar and would not be impacted by sonar transmissions. The distributions of bearded and ringed seals overlap with operational areas of SURTASS LFA sonar in the Sea of Okhotsk, but these are not stocks that experience subsistence hunting. The Alaska Native harvest of harbor seals from twelve stocks identified in Alaska occurs at haul-out sites within the coastal standoff geographic restriction of SURTASS LFA sonar. The remaining four species of pinnipeds (northern fur seal, ribbon seal, spotted seal, and Steller sea lion) experience Native Alaska subsistence hunting and may be exposed to SURTASS LFA sonar transmissions. Pinnipeds are not low-frequency hearing specialists and the potential for impacts from SURTASS LFA sonar are limited to minimal risk for behavioral change.

Should the Navy operate SURTASS LFA sonar in the Gulf of Alaska, sonar operation would adhere to the shutdown in the mitigation and buffer zones, as well as established geographic restrictions, which include the coastal standoff range and OBIAs (which dictates that the sound field produced by the sonar must be below 180 dB re: 1 μPa at 1 m within 22 km (13. mi; 12 nmi) of any coastline or 1 km from the boundary of an OBIA during the time of its biological importance).

Although there are peaks in harvest activity for both species, most subsistence hunting occurs in the winter from January to March when seals have restricted distributions on the ice front. While it is impossible to predict the future timing of the possible employment of SURTASS LFA sonar in the Gulf of Alaska, regardless of the time of year the sonar may be employed in the Gulf of Alaska, there should be no overlap in time or space with subsistence hunts due to the geographic restrictions on the sonar use (*i.e.,* coastal standoff range and OBIA restrictions). These restrictions will prevent the Navy from generating a sound field that reaches the shallow coastal and inshore areas of the Gulf of Alaska where harvest of the two pinniped species occurs. The possible employment of SURTASS LFA sonar in the Gulf of Alaska will not cause abandonment of any harvest/hunting locations, will not displace any subsistence users, nor place physical barriers between marine mammals and the hunters. No mortalities of marine mammals have been associated with the employment of SURTASS LFA sonar and the Navy undertakes a suite of mitigation measures whenever SURTASS LFA sonar is actively transmitting. Therefore, NMFS has preliminarily determined that the possible future employment of SURTASS LFA sonar will not lead to unmitigable adverse impacts on the availability of marine mammal species or stocks for subsistence uses in the Gulf of Alaska or along the Aleutian Island chain.

As part of the public review and comment period for the 2016 DSEIS/SOEIS, letters requesting review were distributed by the Navy to solicit comment from Alaska Native groups on the potential use of SURTASS LFA sonar worldwide. To date, the Navy has not received comments on the DSEIS/SOEIS from Alaska Native groups, nor any requests from Alaskan tribes for government-to-government consultation pursuant to Executive Order 13175. The Navy will continue to keep the Alaskan tribes informed of the timeframes of any future SURTASS LFA sonar exercises planned for the area.

Endangered Species Act

There are 20 marine mammal species under NMFS' jurisdiction that are listed as endangered or threatened under the ESA with confirmed or possible occurrence in potential world-wide mission areas for SURTASS LFA: The blue; fin; sei; humpback (Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, Mexico, and Western North Pacific distinct population segments (DPS)); bowhead; North Atlantic right; North Pacific right; southern right; Western North Pacific DPS of gray; sperm; Cook Inlet DPS of beluga; Main Hawaiian Islands Insular DPS of false killer; and Southern Resident DPS of killer whales, as well as the western DPS of the Steller sea lion; Mediterranean monk seal; Hawaiian monk seal; the Guadalupe fur seal; the Okhotsk ringed seal; the Okhotsk DPS of Pacific bearded seal; and the Southern DPS of spotted seal. In addition, NMFS has proposed to list the Gulf of Mexico Bryde's whale as an endangered species (81 FR 88639, December 8, 2016).

On October 3, 2016, the Navy submitted a Biological Assessment to NMFS to initiate consultation under section 7 of the ESA for the 2017–2022 SURTASS LFA sonar activities and NMFS' authorization for incidental take under section 101(a)(5)(A) of the MMPA. NMFS and Navy will conclude consultation with NMFS's Office of Protected Resources, Interagency Cooperation Division prior to making a determination on the issuance of the final rule and LOAs.

The USFWS is responsible for regulating the take of the several marine mammal species including the southern sea otter, polar bear, walrus, West African manatee, Amazonian manatee, West Indian manatee, and dugong. The Navy has determined that none of these species occur in geographic areas that overlap with SURTASS LFA sonar activities and, therefore, that SURTASS LFA sonar activities will have no effect on the endangered or threatened species or the critical habitat of ESA-listed species under the jurisdiction of the USFWS. Thus, no consultation with the USFWS pursuant to Section 7 of the ESA will occur.

National Environmental Policy Act

Pursuant to the National Environmental Policy Act (NEPA), the Navy has prepared a DSEIS/SOEIS for the specified activity. NMFS is acting as a cooperating agency in the development of the NEPA document.

NMFS plans to adopt the Navy's final SEIS/SOEIS for its action of issuing regulations and LOAs.

The Navy published a Notice of Availability of a DSEIS/SOEIS for employment of SURTASS LFA sonar in the **Federal Register** on August 26, 2016, which was available for public review and comment until October 11, 2016. The public may still view the DSEIS/SOEIS at: *http://www.surtass-lfa-eis.com.*

Prior to issuing the final rule and the first LOA for the proposed activities, NMFS will evaluate the comments received on the DSEIS/SOEIS, comments received as a result of this proposed rulemaking, and the Navy's Final SEIS/SOEIS, and will issue a Record of Decision (ROD).

Classification

This action does not contain any collection of information requirements for purposes of the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 *et seq.*).

The Office of Management and Budget has determined that this proposed rule is not significant for purposes of Executive Order 12866.

Pursuant to the Regulatory Flexibility Act (RFA), the Chief Counsel for Regulation of the Department of Commerce has certified to the Chief Counsel for Advocacy of the Small Business Administration that this proposed rule, if adopted, would not have a significant economic impact on a substantial number of small entities. The RFA requires a Federal agency to prepare an analysis of a rule's impact on small entities whenever the agency is required to publish a notice of proposed rulemaking. However, a Federal agency may certify, pursuant to 5 U.S.C. 605 (b), that the action will not have a significant economic impact on a substantial number of small entities. The Navy is the sole entity that will be affected by this rulemaking and is not a small governmental jurisdiction, small organization, or small business, as defined by the RFA. Any requirements imposed by LOAs issued pursuant to these regulations, and any monitoring or reporting requirements imposed by these regulations, will be applicable only to the Navy.

NMFS does not expect the issuance of these regulations or the associated LOAs to result in any impacts to small entities pursuant to the RFA. Because this action, if adopted, would directly affect the Navy and not a small entity, NMFS concludes the action would not result in a significant economic impact on a substantial number of small entities.

List of Subjects in 50 CFR Part 218

Exports, Fish, Imports, Indians, Labeling, Marine mammals, Penalties, Reporting and recordkeeping requirements, Seafood, Transportation.

Dated: April 17, 2017.

Alan D. Risenhoover,

Acting Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

For reasons set forth in the preamble, 50 CFR part 218 is proposed to be amended as follows:

PART 218—REGULATIONS GOVERNING THE TAKING AND IMPORTING OF MARINE MAMMALS

■ 1. The authority citation for part 218 continues to read as follows:

Authority: 16 U.S.C. 1361 *et seq.*

■ 2. Under part 218, revise Subpart X to read as follows:

Subpart X—Taking and Importing of Marine Mammals; Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar

Sec.

Subpart X—Taking and Importing of Marine Mammals; Navy Operations of Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar

§ 218.230 Specified activity, level of taking, and species.

Regulations in this subpart apply only to the incidental taking of those marine mammal species specified in paragraph (b) of this section by the U.S. Navy, Department of Defense, while engaged in the operation of no more than four SURTASS LFA sonar systems conducting active sonar activities in areas specified in paragraph (a) of this section. The authorized activities, as specified in a Letter of Authorization issued under §§ 216.106 and 218.238 of this chapter, include the transmission of low frequency sounds from the SURTASS LFA sonar system and the transmission of high frequency sounds from the mitigation sonar described in § 218.234 during routine training, testing, and military operations.

(a) The incidental take, by Level B harassment, of marine mammals from the activity identified in this section may be authorized in certain areas of the Pacific, Atlantic, and Indian Oceans and the Mediterranean Sea, as specified in a Letter of Authorization.

(b) The incidental take of marine mammals from the activity identified in this section is limited to the following currently classified species and stocks, and may also cover stocks that represent further formal divisions of these species and stocks of marine mammals, provided that NMFS is able to confirm that the level of taking for those stocks and other factors will be consistent with the findings made for current stocks:

(1) *Mysticetes*–blue whale (*Balaenoptera musculus*), pygmy blue whale (*Balaenoptera musculus brevicauda*), bowhead whale (*Balaena mysticetus*), Bryde's whale (*Balaenoptera edeni*), fin whale (*Balaenoptera physalus*), gray whale (*Eschrichtius robustus*), humpback whale (*Megaptera novaeangliae*), common minke whale (*Balaenoptera acutorostrata*), Antarctic minke whale (*Balaenoptera bonaerensis*), North Atlantic right whale (*Eubalaena glacialis*), North Pacific right whale (*Eubalena japonica*), pygmy right whale (*Capera marginata*), sei whale (*Balaenoptera borealis*), southern right whale (*Eubalaena australis*), Omura's whale (*Balaenoptera omurai*).

(2) *Odontocetes*–Andrew's beaked whale (*Mesoplodon bowdoini*), Arnoux's beaked whale (*Berardius arnuxii*), Atlantic spotted dolphin (*Stenella frontalis*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), Baird's beaked whale (*Berardius bairdii*), Beluga whale (*Dephinapterus leucas*), Blainville's beaked whale (*Mesoplodon densirostris*), Chilean dolphin (*Cephalorhynchus eutropia*), Clymene dolphin (*Stenella clymene*), Commerson's dolphin (*Cephalorhynchus commersonii*), common bottlenose dolphin (*Tursiops truncatus*), Cuvier's beaked whale (*Ziphius cavirostris*), Dall's porpoise (*Phocoenoides dalli*), Deraniyagala's beaked whale (*Mesoplodon hotaula*), Dusky dolphin (*Lagenorhynchus obscurus*), dwarf sperm and pygmy sperm whales *(Kogia simus* and *K. breviceps),* false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei*), Gervais' beaked whale (*Mesoplodon europaeus*), ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*), Gray's beaked whale (*Mesoplodon grayi*), Heaviside's dolphin (*Cephalorhynchus heavisidii*), Hector's

beaked whale (*Mesoplodon hectori*), Hector's dolphin (*Cephalorhynchus hectori*); Hourglass dolphin (*Lagenorhynchus cruciger*), Hubbs' beaked whale (*Mesoplodon carhubbsi*), harbor porpoise (*Phocoena phocoena*); Indo-pacific common dolphin (*Delphinus delphis tropicalis*), Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), killer whale (*Orca orcinus*), long-beaked common dolphin (*Delphinus capensis*), long-finned pilot whale (*Globicephala melas*), Longman's beaked whale (*Indopacetus pacificus*), melon-headed whale (*Peponocephala electra*), northern bottlenose whale (*Hyperodon ampullatus*), northern right whale dolphin (*Lissodelphis borealis*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), pantropical spotted dolphin (*Stenella attenuata*), Peale's dolphin (*Lagenorhynchus australis*), Perrin's beaked whale (*Mesoplodon perrini*), pygmy beaked whale (*Mesoplodon peruvianus*), pygmy killer whale (*Feresa attenuata*), Risso's dolphin (*Grampus griseus*), rough-toothed dolphin (*Steno bredanensis*), Shepherd's beaked whale (*Tasmacetus sheperdii*), short-beaked common dolphin (*Delphinus delphis*), short-finned pilot whale (*Globicephala macrorhynchus*), southern bottlenose whale (*Hyperodon planifrons*), southern right whale dolphin (*Lissodelphis peronii*), Sowerby's beaked whale (*Mesoplodon bidens*), spade-toothed beaked whale (*Mesoplodon traversii*), spectacled porpoise (Phocoena dioptrica), sperm whale (*Physeter macrocephalus*), spinner dolphin (Stenella longirostris), Stejneger's beaked whale (*Mesoplodon stejnegeri*), strap-toothed beaked whale (*Mesoplodon layardii*), striped dolphin (*Stenella coeruleoalba*), True's beaked whale (*Mesoplodon mirus*), white-beaked dolphin (*Lagenorhynchus albirostris*),

(3) *Pinnipeds*–Australian fur seal (*Arctocephalus pusillus doriferus*), Australian sea lion (*Neophoca cinerea*), California sea lion (Zalophus californianus), Eastern (Loughlin's) Steller sea lion (*Eumetopias jubatus monteriensis*), Galapagos fur seal (*Arctocephalus galapagoensis*), Galapagos sea lion (*Zalophus wollebaeki*), Guadalupe fur seal (*Arctocephalus townsendi*), Juan Fernandez fur seal (*Arctocephalus philippi philippi*), New Zealand fur seal (*Arctocephalus forsteri*), New Zealand sea lion (*Phocarctos hookeri*), northern fur seal (*Callorhinus ursinus*), South African or Cape fur seals (*Arctocephalus pusillus pusillus*), South American fur seal (*Arctocephalus australis*), South American sea lion (*Otaria flavescens*), subantarctic fur seal (*Arctocephalus tropicalis*), Western Steller sea lion (*Eumetopiaas jubatus jubatus*), Atlantic gray seal (*Halichoerus grypus atlantica*), Atlantic ringed seal (*Pusa hispida hispida*), Atlantic and Pacific harbor seal (*Phoca vitulina*), harp seal (*Pagophilus groenlandicus*), Hawaiian monk seal (*Monachus schauinslandi*), hooded seal (*Cystophora cristata*), Mediterranean monk seal (*Monachus monachus*), northern elephant seal (*Mirounga angustirostris*), Okhotsk ringed seal (*Pusa hispida ochotensis*), Pacific bearded seal (*Erignathus barbatus nauticus*), ribbon seal (*Phoca fasciata*), southern elephant seal (*Mirounga leonina*), spotted seal (*Phoca largha*).

§ 218.231 Effective dates.

Regulations are effective August 15, 2017, through August 14,

§ 218.232 Permissible methods of taking.

(a) Under Letters of Authorization issued pursuant to §§ 216.106 and 218.238 of this chapter, the Holder of the Letter of Authorization may incidentally, but not intentionally, take marine mammals by Level B harassment within the areas described in (a), provided that the activity is in compliance with all terms, conditions, and requirements of this subpart and the appropriate Letter of Authorization.

(b) The incidental take of marine mammals under the activities identified in § 218.230 is limited to the species listed in § 218.230(b) by the method of take indicated in paragraph (b)(2) of this section.

(1) The Navy must maintain a running calculation/estimation of takes of each species or stock over the effective period of this subpart.

(2) Takes by Level B Harassment will not exceed 12 percent of any marine mammal stock listed in § 218.230(b)(1) through (3) annually over the course of the five-year regulations. This annual per-stock cap of 12 percent applies regardless of the number of LFA vessels operating.

§ 218.233 Prohibitions.

No person in connection with the activities described in § 218.230 may:

(a) Take any marine mammal not specified in § 218.230(b);

(b) Take any marine mammal specified in § 218.230 other than by incidental take as specified in § 218.232(b)(2);

(c) Take any marine mammal specified in § 218.230 if NMFS makes a determination that such taking will result, or is resulting, in more than a negligible impact on the species or stocks of such marine mammal; or

(d)(d) Violate, or fail to comply with, any of the terms, conditions, or requirements of this subpart or any Letter of Authorization issued under § 216.106 and 218.238 of this chapter.

§ 218.234 Mitigation.

When conducting activities identified in § 218.230, the mitigation measures described in this section and in any Letter of Authorization issued under § 216.106 and § 218.238 must be implemented.

(a) *Personnel Training*—Lookouts: (1) The Navy shall train the lookouts in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if they spot marine mammals.

(2) The Navy will hire one or more marine mammal biologist qualified in conducting at-sea marine mammal visual monitoring from surface vessels to train and qualify designated ship personnel to conduct at-sea visual monitoring. This training may be accomplished either in-person, or via video training.

(b) *General Operating Procedures:* (1) Prior to SURTASS LFA sonar activities, the Navy will promulgate executive guidance for the administration, execution, and compliance with the environmental regulations under this subpart and Letters of Authorization.

(2) The Holder of a Letter of Authorization will not transmit the SURTASS LFA sonar signal at a frequency greater than 500 Hz.

(c) *LFA Sonar Mitigation Zone and 1-km Buffer Zone; Suspension and Delay:* (1) Prior to commencing and during SURTASS LFA sonar transmissions, the Holder of a Letter of Authorization will determine the propagation of LFA sonar signals in the ocean and the distance from the SURTASS LFA sonar source to the 180-decibel (dB) re: 1 μPa isopleth.

(2) The Holder of a Letter of Authorization will establish an 180-dB LFA mitigation zone around the surveillance vessel that is equal in size to the 180-dB re: 1 μPa isopleth (*i.e.,* the volume subjected to sound pressure levels of 180 dB or greater) as well as a one-kilometer (1-km) buffer zone around the LFA mitigation zone.

(3) If a marine mammal is detected, through monitoring required under § 218.235, within or about to enter the LFA mitigation zone plus the 1-km buffer zone, the Holder of the Authorization will immediately delay or suspend SURTASS LFA sonar transmissions.

(d) *Resumption of SURTASS LFA sonar transmissions:* (1) The Holder of a Letter of Authorization will not resume SURTASS LFA sonar transmissions earlier than 15 minutes after:

(i) All marine mammals have left the area of the LFA mitigation and buffer zones; and

(ii) There is no further detection of any marine mammal within the LFA mitigation and buffer zones as determined by the visual, passive, and high frequency monitoring described in § 218.235.

(2) [Reserved]

(e) *Ramp-up Procedures for the high-frequency marine mammal monitoring (HF/M3) sonar required under § 218.235:* (1) The Holder of a Letter of Authorization will ramp up the HF/M3 sonar power level beginning at a maximum source sound pressure level of 180 dB: re 1 μPa at 1 meter in 10-dB increments to operating levels over a period of no less than five minutes:

(i) At least 30 minutes prior to any SURTASS LFA sonar transmissions;

(ii) Prior to any SURTASS LFA sonar calibrations or testing that are not part of regular SURTASS LFA sonar transmissions described in § 218.230; and

(iii) Anytime after the HF/M3 source has been powered down for more than two minutes.

(2) The Holder of a Letter of Authorization will not increase the HF/M3 sound pressure level once a marine mammal is detected; ramp-up may resume once marine mammals are no longer detected.

(f) *Geographic Restrictions on the SURTASS LFA Sonar Sound Field:* (1) The Holder of a Letter of Authorization will not operate the SURTASS LFA sonar such that:

(i) The SURTASS LFA sonar sound field exceeds 180 dB re: 1 μPa (rms) at a distance less than 12 nautical miles (nmi) (22 kilometers (km)) from any land, including offshore islands;

(ii) The SURTASS LFA sonar sound field exceeds 180 dB re: 1 μPa (rms) at a distance less than 1 km (0.5 nm) seaward of the outer perimeter of any Offshore Biologically Important Area (OBIA) designated in § 218.234(f)(2), or identified through the Adaptive Management process specified in § 218.241, during the period specified. The boundaries and periods of such OBIAs will be kept on file in NMFS' Office of Protected Resources and on its Web site at *http://www/nmfs.noaa.gov/pr/permits/incidental/military.htm*.

(2) Offshore Biologically Important Areas (OBIAs) for marine mammals (with specified periods) for SURTASS LFA sonar activities include the following:

Name of area	Location of area	Months of importance
Georges Bank	Northwest Atlantic Ocean	Year-round.
Roseway Basin Right Whale Conservation Area	Northwest Atlantic Ocean	June through December, annually.
Great South Channel, U.S. Gulf of Maine, and Stellwagen Bank National Marine Sanctuary (NMS).	Northwest Atlantic Ocean/Gulf of Maine	January 1 to November 14, annually.
Southeastern U.S. Right Whale Habitat	Northwest Atlantic Ocean	November 15 to January 15, annually.
Gulf of Alaska	Gulf of Alaska	March through August, annually.
Navidad Bank	Caribbean Sea/Northwest Atlantic Ocean	December through April, annually.
Coastal waters of Gabon, Congo and Equatorial Guinea.	Southeastern Atlantic Ocean	June through October, annually.
Patagonian Shelf Break	Southwestern Atlantic Ocean	Year-round.
Southern Right Whale Seasonal Habitat	Southwestern Atlantic Ocean	May through December, annually.
Central California	Northeastern Pacific Ocean	June through November, annually.
Antarctic Convergence Zone	Southern Ocean	October through March, annually.
Piltun and Chayvo offshore feeding grounds	Sea of Okhotsk	June through November, annually.
Coastal waters off Madagascar	Western Indian Ocean	July through September, annually for humpback whale breeding and November through December, annually for migrating blue whales.
Madagascar Plateau, Madagascar Ridge, and Walters Shoal.	Western Indian Ocean	November through December, annually.
Ligurian-Corsican-Provencal Basin and Western Pelagos Sanctuary.	Northern Mediterranean Sea	July to August, annually.
Penguin Bank, Hawaiian Islands Humpback Whale NMS.	North-Central Pacific Ocean	November through April, annually.
Costa Rica Dome	Eastern Tropical Pacific Ocean	Year-round.
Great Barrier Reef Between	Coral Sea/Southwestern Pacific Ocean	May through September, annually.
Bonney Upwelling	Southern Ocean	December through May, annually.
Northern Bay of Bengal and Head of Swatch-of-No-Ground (SoNG).	Bay of Bengal/Northern Indian Ocean	Year-round.
Olympic Coast NMS and Prairie, Barkley Canyon, and Nitnat Canyon.	Northeastern Pacific Ocean	Olympic NMS: December, January, March, and May annually. Prairie, Barkley Canyon, and Nitnat Canyon: June through September annually.
Abrolhos Bank	Southwest Atlantic Ocean	August through November, annually.
Grand Manan North Atlantic Right Whale Critical Habitat.	Bay of Fundy, Canada	June through December, annually.
Eastern Gulf of Mexico	Eastern Gulf of Mexico	Year-round.
Southern Chile Coastal Waters	Gulf of Corcovado, Southeast Pacific Ocean; Southwestern Chile.	February to April, annually.
Offshore Sri Lanka	North-Central Indian Ocean	December through April, annually.
Camden Sound/Kimberly Region	Southeast Indian Ocean; northwestern Australia.	June through September, annually.
Perth Canyon	Southeast Indian Ocean; southwestern Australia.	January through May, annually.

(g) *Operational Exception for the SURTASS LFA Sonar Sound Field.* During military operations SURTASS LFA sonar transmissions may exceed 180 dB re: 1 µPa (rms) within the boundaries of a SURTASS LFA sonar OBIA when:

(1) Operationally necessary to continue tracking an existing underwater contact; or

(2) Operationally necessary to detect a new underwater contact within the OBIA. This exception does not apply to routine training and testing with the SURTASS LFA sonar systems.

§ 218.235 Requirements for monitoring.

(a) The Holder of a Letter of Authorization issued pursuant to §§ 216.106 and 218.238 must:

(1) Conduct visual monitoring from the ship's bridge during all daylight hours (30 minutes before sunrise until 30 minutes after sunset). During activities that employ SURTASS LFA sonar in the active mode, the SURTASS vessels shall have lookouts to maintain a topside watch with standard binoculars (7x) and with the naked eye.

(2) Use low frequency passive SURTASS sonar to listen for vocalizing marine mammals; and

(3) Use the HF/M3 sonar to locate and track marine mammals in relation to the SURTASS LFA sonar vessel and the sound field produced by the SURTASS LFA sonar source array, subject to the ramp-up requirements in § 216.234(e) of this chapter.

(b) Monitoring under paragraph (a) of this section must:

(1) Commence at least 30 minutes before the first SURTASS LFA sonar transmission;

(2) Continue between transmission pings; and

(3) Continue either for at least 15 minutes after completion of the SURTASS LFA sonar transmission exercise, or, if marine mammals are exhibiting unusual changes in behavioral patterns, for a period of time until behavior patterns return to normal or conditions prevent continued observations.

(c) Holders of Letters of Authorization for activities described in § 218.230 are required to cooperate with the National Marine Fisheries Service and any other federal agency for monitoring the impacts of the activity on marine mammals.

(d) The Navy must designate qualified on-site individuals to conduct the mitigation, monitoring and reporting activities specified in the Letter of Authorization.

(e) Holders of Letters of Authorization will continue to assess data from the Marine Mammal Monitoring Program and work toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances. Any portions of the analyses conducted by these scientists based on these data that are determined to be unclassified after appropriate security reviews will be made publically available.

(f) Holders of Letters of Authorization will collect ambient noise data and will explore the feasibility of declassifying and archiving the ambient noise data for incorporation into appropriate ocean noise budget efforts.

(g) Holders of Letters of Authorization must conduct all monitoring required under the Letter of Authorization.

§ 218.236 Requirements for reporting.

(a) The Holder of a Letter of Authorization must submit classified and unclassified quarterly mission reports to the Director, Office of Protected Resources, NMFS, no later than 45 days after the end of each quarter beginning on the date of effectiveness of a Letter of Authorization or as specified in the appropriate Letter of Authorization. Each quarterly mission report will include a summary of all active-mode missions completed during that quarter. At a minimum, each classified mission report must contain the following information: (1) Dates, times, and location of each vessel during each mission;

(2) Information on sonar transmissions during each mission;

(3) Results of the marine mammal monitoring program specified in the Letter of Authorization; and

(4) Estimates of the percentages of marine mammal species and stocks affected (both for the quarter and cumulatively for the year) covered by the Letter of Authorization.

(b) The Holder of a Letter of Authorization must submit an unclassified annual report to the Director, Office of Protected Resources, NMFS, no later than 60 days after the expiration of a Letter of Authorization. The reports must contain all the information required by the Letter of Authorization.

(c) The fifth annual report shall be prepared as a final comprehensive report, which will include information for the final year as well as the prior four years of activities under the rule. This final comprehensive report must also contain an unclassified analysis of new passive sonar technologies and an assessment of whether such a system is feasible as an alternative to SURTASS LFA sonar, and shall be submitted to the Director, Office of Protected Resources, NMFS as described in paragraph (b) of this section.

(d) The Navy will continue to assess the data collected by its undersea arrays and work toward making some portion of that data, after appropriate security reviews, available to scientists with appropriate clearances. Any portions of the analyses conducted by these scientists based on these data that are determined to be unclassified after appropriate security reviews will be made publically available. The Navy will provide a status update to NMFS when it submits an annual application for the Letters of Authorization.

§ 218.237 Applications for letters of authorization.

(a) To incidentally take marine mammals pursuant to this subpart, the U.S. Navy authority conducting the activity identified in § 218.230 must apply for and obtain a Letter of Authorization in accordance with § 216.106 of this chapter.

(b) The application for a Letter of Authorization must be submitted to the Director, Office of Protected Resources, NMFS, at least 60 days before the date that either the vessel is scheduled to begin conducting SURTASS LFA sonar activities or the previous Letter of Authorization is scheduled to expire. If the Navy will change mission areas, or if there are other substantial modifications to the described activity, mitigation, or monitoring undertaken during the upcoming period, the Navy will submit its application for a Letter of Authorization at least 90 days before the date that either the vessel is scheduled to begin conducting SURTASS LFA sonar activities or the previous Letter of Authorization is scheduled to expire.

(c) All applications for a Letter of Authorization must include the following information:

(1) The area(s) where the vessel's activity will occur;

(2) The species and/or stock(s) of marine mammals likely to be found within each area;

(3) The type of incidental taking authorization requested (*i.e.,* take by Level B harassment);

(4) The estimated percentage of marine mammal species/stocks potentially affected in each area for the period of effectiveness of the Letter of Authorization; and

(5) The means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and the level of taking or impacts on marine mammal populations.

(d) The National Marine Fisheries Service will review an application for a Letter of Authorization in accordance with § 216.104(b) of this chapter and, if adequate and complete, issue a Letter of Authorization.

§ 218.238 Letters of authorization.

(a) A Letter of Authorization, unless suspended or revoked, will be valid for a period of time not to exceed one year, but may be renewed annually subject to renewal conditions in § 218.239.

(b) Each Letter of Authorization will set forth:

(1) Permissible methods of incidental taking;

(2) Authorized geographic areas for incidental takings;

(3) Means of effecting the least practicable adverse impact on the species of marine mammals authorized for taking, their habitat, and the availability of the species for subsistence uses; and

(4) Requirements for monitoring and reporting incidental takes.

(c) Issuance of a letter of authorization will be based on a determination that the level of taking will be consistent with the findings made for the total taking allowable under this subpart.

(d) Notice of issuance or denial of an application for a Letter of Authorization will be published in the **Federal Register** within 30 days of a determination.

§ 218.239 Renewal of letters of authorization.

(a) A Letter of Authorization issued for the activity identified in § 218.230 may be renewed upon:

(1) Notification to NMFS that the activity described in the application submitted under § 218.237 will be undertaken and that there will not be a substantial modification to the described activity, mitigation or monitoring undertaken during the upcoming period;

(2) Notification to NMFS of the information identified in § 218.237(c);

(3) Timely receipt of the monitoring reports required under § 218.236, which have been reviewed by NMFS and determined to be acceptable;

(4) A determination by NMFS that the mitigation, monitoring and reporting measures required under §§ 218.234, 218.235, and 218.236 and the previous Letter of Authorization were undertaken and will be undertaken during the upcoming period of validity of a renewed Letter of Authorization; and

(5) A determination by NMFS that the level of taking will be consistent with the findings made for the total taking allowable under this subpart, including for newly identified stocks that represent smaller divisions of species or stocks listed in § 218.230(b).

(b) If a request for a renewal of a Letter of Authorization indicates that a substantial modification to the described work, mitigation, or monitoring will occur, or if NMFS proposes a substantial modification to the Letter of Authorization, NMFS will provide a period of 30 days for public review and comment on the proposed modification. Modifying OBIAs is not considered a substantial modification to the Letter of Authorization.

(c) A notice of issuance or denial of a renewal of a Letter of Authorization will be published in the **Federal Register** within 30 days of a determination.

§ 218.240 Modifications to letters of authorization.

(a) Except as provided in paragraph (b) of this section, no substantial modification (including withdrawal or suspension) to a Letter of Authorization subject to the provisions of this subpart shall be made by NMFS until after notification and an opportunity for public comment has been provided.

(b) If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in § 218.230(b)(1), (2), or (3), NMFS may modify a Letter of Authorization without prior notice and opportunity for public comment. Notification will be published in the **Federal Register** within 30 days of the action.

§ 218.241 Adaptive management.

NMFS may modify or augment the existing mitigation or monitoring measures (after consulting with the Navy regarding the practicability of the modifications) if doing so creates a reasonable likelihood of more effectively accomplishing the goals of mitigation and monitoring. NMFS will provide a period of 30 days for public review and comment if such modifications are substantial. Amending the areas for upcoming SURTASS LFA sonar activities or OBIA boundaries are not considered substantial modifications to the Letter of Authorization. Below are some of the possible sources of new data that could contribute to the decision to modify the mitigation or monitoring measures:

(a) Results from the Navy's monitoring from the previous year's operation of SURTASS LFA sonar).

(b) Compiled results of Navy-funded research and development studies.

(c) Results from specific stranding investigations.

(d) Results from general marine mammal and sound research funded by the Navy or other sponsors.

(e) Any information that reveals marine mammals may have been taken in a manner, extent or number not anticipated by this subpart or subsequent Letters of Authorization.

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